THE

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ELECTRICAL REVIEW.

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DR. GLAZEBROOK'S ADDRESS.

THERE can be no doubt that the improvement of engineering practice in the details of mechanical workmanship, and in the materials employed, is receiving close and systematic attention through the whole country. It is somewhat hard to persuade Englishmen to change their habits of thought or practice, but when it is done the effect is likely to be far-reaching and effective. The commercial development of Germany and the United States, and in a lesser, though still striking, degree of Switzerland and Italy, as well as the growth of Canada promising to surpass anything we have seen of the kind, have convinced business concerns of this country that it is worth their while to study business methods other than those which have made them wealthy in the past. We may have played a little, and taken things a little easy, but there is no doubt that our manufacturers have adapted themselves to the new conditions, and the present is certainly a time of exceptional activity.

Dr. Glazebrook's address to the Institution of Electrical Engineers was an informal report of progress of a great piece of work in the general direction of engineering advance. The engineering profession is to be congratulated on its good fortune in that a director was found for the National Physical Laboratory who, after long service in the severest philosophic school in the world—the Cambridge school of mathematical physics — retains keen sympathy with the difficulties of commercial mechanics. His election to the Presidential chair of the Electrical Engineers is a satisfactory recognition of the service he is rendering to us all, and his address on Electrical Standards and the work of the Standards Committees was appropriate to the occasion of his assuming that chair. The work of these Committees is curiously sober and conservative. Those who have followed the published reports of their work, or have heard addresses delivered by their members, can realise how great pains have been taken to ascertain the views of outside individuals, and to prevent any overriding of legitimate interest or prejudice. The account by Dr. Glazebrook of one piece of work, viz., the construction of a set of terms and grades, to describe the departures from their nominal dimensions of the cylindrical parts of machinery, gives a good idea of the trouble that has been taken to find out what may be laid down as average good practice. We are not very clear as to the exact effect of the conclusions arrived at in this particular case, and should have liked to hear more of the way in which they are expected to be applied, but we understand that all the reports, when issued, are to some extent tentative, and their success depends upon the way in which they are acted on by manufacturers and engineers. The use already made of the recommendations on shipbuilders' sections, tramway rails, &c., is very encouraging.

The main topic of the address was a question upon which

very much might be written. Is standardisation useful, how far, and what should be its limits? There can be no doubt in anyone's mind as to its value in a great many instances. Bolts and nuts, taper pins, plugs, keys, pulleys, shafting, spanners, gas pipes, and hundreds of small appliances must be made to standard sizes. And there can be little difference of opinion as to the sections of electric light cables, tramway rails, incandescent lamps, angles, channels and tees, and the list might be indefinitely extended. There is nothing to be gained by varying such things as these. Their uses are simple, well understood and clearly defined, and one wants nothing more than a reasonable variety of sizes from which to select. The possible economy of labour, and staff expenses, as well as the possible improvement in the efficiency of manufacturing plant, given standard sizes and a large market, are almost unlimited. But as soon as one leaves the simpler elements of engineering construction the question becomes far more difficult. One of the most dangerous things to standardise would seem to be tests on machinery or materials. The history of cement testing contains, we believe, some curious incidents, and testing the quality of castings by test pieces cast on is apt to be very misleading.

Serious doubts have been expressed as to the wisdom of adopting any standard rules for the rating of electrical machinery. No doubt standard ratings for motors, and generally-accepted methods for determining temperatures, the limits of injurious sparking or safe periods of overload, would be useful to many people, and especially to those manufacturers who, maintaining a high standard of performance, suffer in competition with others who exaggerate the merits of their machines, or rate them by a lower standard. But, on the other hand, the adoption of standard tests may easily interfere with the introduction of some new design or some new material for the trial of which they are not suited, so that the new product does not get tried purely on its merits. Moreover, the wits of a small minority will be actively exercised to devise, and will succeed in devising, ways of evading the spirit of the regulations. It is difficult to alter legislation for single cases, and yet they may be very hard ones. Practice is apt to crystallise, and the better the practice, the larger the crystals.

Standardisation will certainly strengthen the hands of large highly organised and highly equipped factories, by helping them to become so efficient that no smaller firm can compete with them on standard products. The process of eliminating the less efficient is always taking place by natural causes, but standardisation may accelerate it. This is, doubtless, to be reckoned to the good, since the struggle for existence will be better directed, even if it become harder.

Another effect will be to assist consulting engineers to draw specifications which neither favour nor harass anyone, thus helping to relieve the irritation, much less frequent than formerly, but often inevitable, between engineers and contractors, and this again is all to the good.

Intelligent standardisation may give us such command of our own markets as to protect them to a greater degree than any tariff wall could do. Reading between the lines of the politics of the last four years, it would seem that the engineering business of this country is convinced that it can meet foreign competition by its own efforts and without Government assistance, and the work of the Standards Committees seems to be one of these efforts. We wish them every success.

The L.G.B. and Walthamstow.

Having got over its trouble concerning the supply of cables, Walthamstow again finds itself in a municipal mire. The Local Government Board several weeks ago sent to the Urban District Council their observations upon the inquiry recently held there by Mr. Hooper respecting loans required for the electricity undertaking. A number of items were not sanctioned because they were properly chargeable against revenue. Further, the Board have not allowed a sum of £535, part of £1,075 for 135 house services (average £8 each), as they regard the price as extravagant, especially seeing that the new resident engineer considers that the work could properly be done at an average cost of £4 per service, a view in which the Board concur. They also do not allow a sum of £1,110 for motors for hire, as they have already pointed out that the Council has no power to provide motors in this way. A small amount (£45) for street lighting by Tantalum lamps is not approved because of the relative cost of lighting by gas and electricity (here we do not agree with the Board) and because of the present financial position of the undertaking. The Board's feeling is that it is inadvisable to incur any capital expenditure that can properly be deferred. And this is at "successful" Walthamstow! Here is an example of the limitations of municipal enterprise. Things have got to such a pass that capital expenditure must be restricted to the utmost, with the natural result that the full development of electricity has to be hindered. It is an interesting question whether private companies would not have been able to proceed with greater enterprise and with no Government restriction as to capital outlay. Certainly there would be no wanton indulgence in extension work, and no allocation of £8 where £4 would have been sufficient. Business men may be trusted to calculate before they spend. As long as they are wanting capital for profitable employment they can obtain it from the public, and at not so very much below par value as in the case of municipal stocks. We have no doubt whatever that the L.G.B., in advocating municipal caution, is doing quite the right thing, though it may not be immediately advantageous to the electrical industry to have purchasing stopped. The present stage of municipal electricity control at Walthamstow shows that it is not beneficial to the industry, nor has it been a financial success to the ratepayers. And there are many other towns where sooner or later, we believe, the L.G.B. will have to say, "It is inadvisable to incur any capital expenditure that can properly be deferred," because of "the present financial condition of the undertaking."

But let us proceed with this most interesting document. The most startling part of the whole report is its references to the general state of the electricity works and their equipment. We quote, and in doing so, would express an earnest hope that there are not many public electricity works, in this country at any rate, to which such a description can be truthfully applied :—

> The inspector's report discloses a very serious condition of affairs at the generating station. Much of the plant appears to be of inferior quality and faulty design, and owing apparently to neglect or incompetence on the part of the late resident engineer, has been allowed to get into a very bad state. The unsatisfactory condition of the machinery is clearly shown by the tests conducted by Mr. Spurr, from which it appears that the generating plant has only a capacity of 1,531 KW. against the rated capacity of 1,800 KW.
>
> Further, the inspector reports that the station building itself is dirty and ill-kept, and amongst other defects he noticed that the roof over the gas plant had corroded away.
>
> It is evident from this account that a considerable further expenditure of money will be required to put the works into a proper state of efficiency, and the Board consider that the position in which the Council find themselves placed is such as to reflect serious discredit on their late resident engineer, and to some extent on their consulting engineer.

Surely, only under municipal control, and with such a remarkable body of Councillors as the Walthamstow U.D.C. is for the most part composed of, could this sort of thing be at all possible!

We sympathise with Mr. Spurr, the present engineer, upon the disagreeable task that has devolved upon him at the commencement of his service at Walthamstow. We do not doubt that he will be quite equal to the occasion, but in the work of remedying the present state of affairs he will need the full support and confidence of his committee. The constitution of the Council makes Walthamstow one of those places where the engineer must *lead* his councillors.

Wireless Telegraphy.

In view of the attention which has been drawn to the subject of wireless telegraphy by recent events, we anticipate that the space which we have devoted to it in this issue will be well occupied. Besides an illustrated description of the latest and most important installation in Germany, in the execution of which several novel departures have been made, we give an article from an authoritative source on the subject of the recent Conference, and an account of the exceedingly interesting system of producing undamped oscillations devised by Mr. Valdemar Poulsen, with Mr. W. D. Duddell's researches on the "singing arc" as a basis. The great difficulty which has hitherto baffled all attempts at accurate tuning has been the inability to produce a continuous train of electric waves, of uniform amplitude and frequency, suitable for use in the transmission of signals. Moreover, the low efficiency of the spark-gap system has necessitated an extravagant consumption of power, and the fusillade of sparks has proved a nuisance to all in the vicinity. All these difficulties, it seems, will be swept away by the introduction of the new system, in which an electric arc quietly and economically gives rise to a perfectly definite and continuous train of equal waves.

It may be that the system is not yet sufficiently developed for long-distance transmission; but this is of far less importance than working over distances of a few hundred miles, and further, Mr. Poulsen, whose invention of the telegraphone was one of the most remarkable achievements in the history of electrical science, may be trusted to develop his new system to the utmost limit.

We may point out that this is a new and striking instance of the fact to which we have often drawn attention—that pure scientific research, carried out for the love of it, very often leads, sooner or later, to practical results of importance undreamt of by the investigator; and Mr. Duddell deserves full credit for the work by which he made possible the present step in advance.

Pacific Cable.

Since our leader of September 21st was written, it appears that Mr. Reynolds, manager of the Pacific Cable Board, while in Canada, stated that during his four months' visit to Australia, the Pacific Cable Board had been able to secure the needed facilities for doing business with the public there. The Melbourne office of the Eastern Extension Co., which, by the terms offered by the Australian Government, was to be retained by the company until 1915, has been closed owing to its refusal to accept them, and the Pacific cable is expected to get a much larger share of business in consequence of this.

In Sydney the Eastern Co. has perpetual rights, and the Pacific Cable Board has been obliged to obtain the sanction of the Government to open an office and conduct business as a competing company. Similarly, the Board reserves the right to open competing offices in Perth and Adelaide. It is good news to hear that the Pacific Cable has gained more business freedom, and it may be confidently expected that the contributions — which are unwisely referred to as "deficit" in the accounts—will be less in the future and eventually, perhaps, will become practically unnecessary. The word "deficit" is a misnomer. The Eastern and German Companies receive large Government subsidies, and they would probably also show "deficits" if they were not in receipt of them. The German Government pays over £80,000 per annum to the German Atlantic Cable Co., and £76,250 for the Dutch-German system, and why should our Colonies and this country grumble because they have together to provide a similar sum? The contributions towards the Pacific Cable by Great Britain and the interested Colonies are payments in respect of a "traffic guarantee," and they cannot be deemed to be very onerous. In the accounts for 1906 the amounts contributed were as follows:—£20,154 9s. 4d. by England; £20,154 9s. 5d. by Canada; £24,185 7s. 3d. by Australia; and £8,061 15s. 9d. by New Zealand. Given proper freedom and facilities, we see no reason why the Pacific Cable should not become independent of such contributions altogether.

Suction Gas Power.

Those of our readers who have followed the recent controversy in our "Correspondence" columns will probably be interested in the two articles on this subject which appear in our pages to-day. Both of these came to hand this month; one is an actual record of working costs, while the other gives estimates, based upon the makers' guarantees, of the working costs of two installations of equal size, but driven respectively by gas and steam power.

The former shows that, under ordinary working conditions, the cost of fuel per unit generated is from 0·367d. per unit to 0·46d., or from 0·25d. per B.H.P.-hour to 0·3d. To this must be added interest and depreciation, wages, repairs, water and oil, &c., and it will be noticed that Mr. Tookey estimates the total cost per unit in the case detailed at 1·5d.

The second article furnishes a quantity of data which will be found useful for the purpose of instituting comparisons when preparing similar estimates.

Recording Telephone Calls.

The rumour which was afoot some weeks ago to the effect that the National Telephone Co. intended to abolish the "unlimited service" system in favour of the penny-a-call system, although it was promptly denied, attracted a good deal of attention. While the latter, as everyone acquainted with the working of a telephone service will agree, is undoubtedly the more equitable system of charging, and the proper basis upon which to establish such a business, much doubt has been thrown upon the accuracy with which it has been carried out in practice, by correspondents of the non-technical Press.

Telephone subscribers writing to the *Daily Mail* accused the Post Office of serious overcharges, one gentleman having instituted a most careful and systematic register of effective calls, which showed that numerous calls had been wrongly recorded against him. Our contemporary *Truth*, taking up the question, brought forward additional and weighty evidence in the same sense. As the accuracy of the record depends entirely upon the operator, who is supposed to press a button once for every effective call emanating from the subscriber's station, it is quite possible that occasionally unanswered calls may be recorded as effective, or, on the other hand, that at busy times the operator may forget to record calls—an aspect of the question which does not appear to have attracted the attention of the aforesaid correspondents.

As the meter records afford an indication of the work done by the operators, which is taken into consideration with a view to equalising their burden, it is conceivable that an unscrupulous or lazy operator might find it advantageous to record an excessive number of calls with a view to securing lighter work; but whether such a proceeding has been met with we cannot say. We have both systems of charging in use at this office, and we have not experienced any overcharge, so far as we are aware.

D

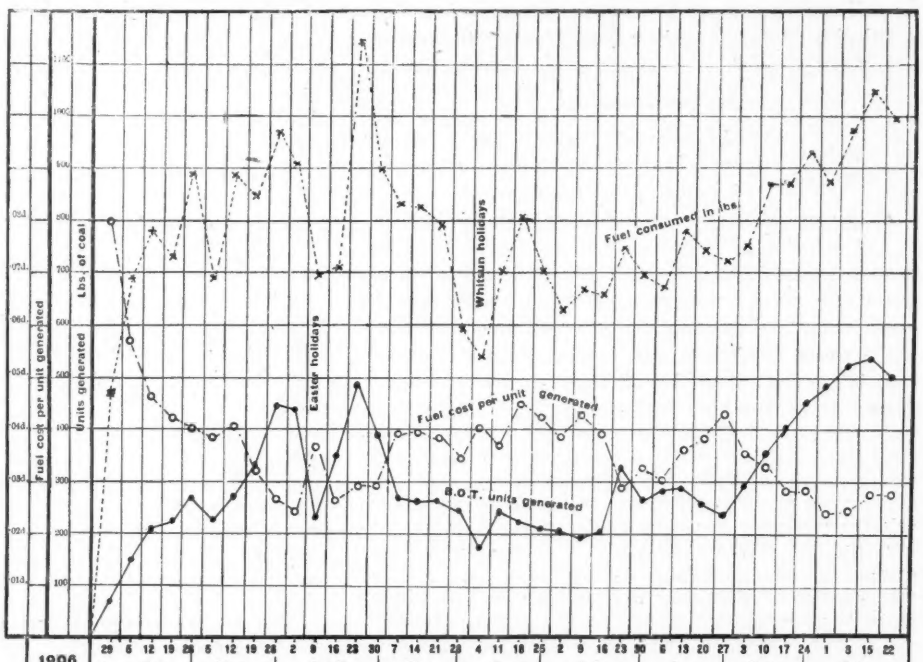
COST OF SUCTION GAS POWER.

We have received the following interesting communication from Mr. W. A. Tookey, the well-known authority on the production of power by gas engines, &c. :—

With reference to recent correspondence upon this subject in your columns, I think it would be interesting to your readers to see a record based upon actual working fuel costs, and I have prepared the accompanying chart from a log-book systematically and carefully kept by Mr. L. A. Jinks, electrical engineer, 20, Princes Street, Cavendish Square, W. The plant consists of a 20-B.H.P. Fielding gas engine driving a dynamo by chain belt. The gas is supplied by one of Welch, Benham and Co.'s suction gas producers.

The equipment is under Mr. Jinks's personal supervision, but is actually attended to by a man, employed in other duties, previously without any knowledge either of gas engines or of gas production.

The chart has been prepared from figures which include the amount of coal fed to the generator for all purposes. The fire is kept continually burning for as long as six or seven weeks. The number of working hours per week averages over 60, so that over 100 hours stand-by losses each week are included in the log.



Record kept by Mr. L. Ashton Jinks, electrical engineer, 20, Princes Street, Cavendish Square, W. 20-B.H.P. Fielding gas engine and Welch, Benham & Co.'s "A. B. C." suction gas producer, supplying electricity for lighting, heating and cooking for business premises. Average fuel cost per B. of T. unit generated for whole period = 0·967d., including all stand-by losses.

The curve showing fuel cost per unit generated has been based upon the actual prices paid for each consignment. This curve is affected by the price of coal, the quality of coal, and the amount of waste due to clinkering of inferior fuels.

There has been no attempt to rival manufacturers' figures or to do other than record the results achieved, in a thoroughly impartial manner.

The log itself emphasises not only the reliability of suction producers, but also their economy under varying loads such as apply to ordinary factory conditions. But I think that it is necessary to point out that the engine has been started whenever convenient—sometimes half an hour before actually necessary. Again, during meal times, the engine has been still kept at work with practically nothing to do and, after business hours, the engine has been stopped an hour or sometimes two hours after the maximum load has dropped off.

Under these circumstances the average fuel cost per B. of T. unit generated, during nine months, is only ·367 of 1d. This is an achievement which is thoroughly satisfactory in every way. Better results may be anticipated for a complete year including winter months.

Supplementing the figures above noted, I may add that Mr. H. M. Leaf, electrical engineer, of 47, Victoria Street, Westminster, informs me that similar records, kept at many country house installations for which he is responsible, show that the fuel cost, including stand-by losses, amounts only to ·46d. or thereabouts. This is to be expected, as battery charging is not carried on each day, and the consumption of coal would be increased owing to the relighting of fires and consequent loss of heat and waste of fuel.

I present these figures to your readers as representing actual fuel costs. Neither Mr. Jinks nor Mr. Leaf has found that any large expense has been necessary for renewals or repairs even with installations that have already completed over two years of service. Attendants' wages are in all cases quite a small amount—their time being mainly spent upon other operations about the houses or factories.

The chart gives evidence upon the most important working cost. Your readers can complete the total costs of interest, depreciation, renewals, stores and wages as may be necessary to provide comparison with other forms of prime movers to suit particular circumstances. In Mr. Jinks's case, I compute that he is running his installation at a complete cost of 1·5d. per unit, and saving a considerable sum on his "lighting" bill.

WIRELESS TELEGRAPHY BY MEANS OF UNDAMPED OSCILLATIONS.*

By VALDEMAR POULSEN, Copenhagen.

A wireless telegraph system based upon undamped oscillations, must by its perfect tuning allow a large number of stations to telegraph over the same district without interfering with each other. The starting point of the new system is Mr. Duddell's discovery, that if a circuit of suitable capacity and self-induction is connected in parallel to a direct-current arc (fig. 1), then under certain conditions the arc gives a musical note. At the same time in the self-induction capacity circuit there is set up an alternating current of the same frequency as the note of the arc. The continuous current is partly changed into an alternating one of a constant amplitude, and its

* Abstract of an experimental lecture given by Mr. Poulsen before the Elektrotechnische Verein, at a meeting in honour of the International Conference on Wireless Telegraphy, October 23rd, 1906. See the *E.T.Z.* November 8th, 1906.

energy can only be taken from the direct current energy. Calling $d\,v$ the change of potential in the arc in the time $d\,t$, and $d\,i$ the corresponding change of current in the arc, $\frac{d\,v}{d\,i}$ must be negative and numerically larger than the resistance of the alternating-current circuit, a condition easily fulfilled.

From the standpoint of alternating-current engineering, Mr. Duddell obtained very high frequencies, 30,000 or 40,000 oscillations per second; but in wireless telegraphy this frequency appears low.

About three years and a half ago Mr. Poulsen found means to change the physical experiment of the "singing arc" into a technical device for the generation of undamped oscillations. This was accomplished by putting the arc into a hydrogen atmosphere. Then, under certain conditions, the frequency obtained is much higher than before—namely, a million per second. That these oscillations are really free from damping has been shown by different laboratory methods and by experiments on a larger scale in their application to wireless telegraphy.

At first the arc was placed horizontally, so that it could be brought into the flame of a spirit lamp (fig. 2), but higher frequencies, than in the vapour of the spirit flame, were obtained in gas, hydrogen or ether; ammonia also had a good effect. As important as the raising of the frequency in these cases, is the intensity of the oscillations. It is necessary to draw the arc to a certain length, viz., the "active length." This active length increases with the strength of the direct current and diminishes with growing frequency. The product of the self-induction by the capacity may be changed within wide limits without interrupting the oscillations.

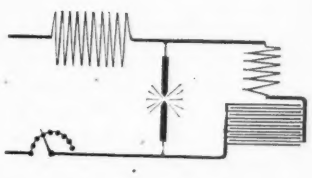


Fig. 1.

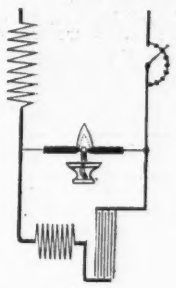


Fig. 2.

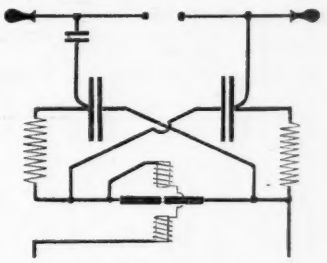


Fig. 3.

In the beginning, the favourable effect of hydrogen was ascribed to cooling, but pure nitrogen and certain other gases also give a fairly high frequency; in air the presence of oxygen seems to be the obstacle, whether it be that the difference is caused by the heat of combustion or by a mechanical damping in consequence of the chemical action, or by both. The great velocity of the hydrogen atom is accompanied by a high conductivity for heat and a great velocity of ionisation. Therefore, the effect is supposed to be not merely a thermal, but an electric one. In fact, the efficiency is raised by cooling, as, for example, by using an anode of copper or by employing water circulation.

Experiments have shown that setting up a magnetic field at right angles to the arc raises the efficiency, as then the position of the arc is geometrically fixed and the oscillations are more steady. The coils of the electro-magnet may be used as choking coils as well. In order to keep the length of the arc constant for a longer period, the carbon may revolve round its axis. The velocity of this may be very small, for example, 0·1 mm. per second. The arc is enclosed in a suitable box, the sides of which are of marble, and the gas is introduced directly under the arc or through a hole in the anode. As a rule, hydrogen with hydro-carbon is better than hydrogen alone, so usually ordinary coal-gas is used. It is very interesting and theoretically important that the gas is changed in passing the arc, of course by the oscillating and not by the direct current. It loses its activity, and loses it the more the greater the energy of the oscillations. It is possible to regenerate the gas to its former activity.

Fig. 3 shows the generator for undamped electric oscillations, with which Mr. Poulsen made some very striking experiments, the frequency being about 700,000 per second, and the voltage very high, although the direct current feeding the arc had only 450 volts pressure.

In order to raise the energy sent out in oscillations, one may employ several arcs instead of one, in series or in parallel. So there may be sent out, for instance, 1,200 watts with 160,000 periods per second, or 900 watts with 240,000 periods.

Leaving theory, and coming to wireless telegraphy, the transmitter is of interest with regard to two points, coupling and signalling. For coupling there are the two old methods, either direct or by transformer. In spark telegraphy tuning was only possible with loose coupling, but as the efficiency of the transmission required some energy, the loose coupling was confined to certain limits. The new system gives equally good results both with loose and with tight coupling.

The signalling is done by different methods, for example, either by bringing aerial and counterpoise into and out of connection with the feeding circuit, in which oscillations are going on without interruption, or by putting a fairly high resistance into the generator or aerial. On the whole, it is characteristic of the new system that the transmitting key is affected only to a very small degree. The sparks are usually only of a microscopic size. In fact, the energy per unit of time is much smaller than it formerly was.

The receiver is constructed largely on the resonance principle. In consequence of the continuity of the waves, which arrive through space, the detector need be in the circuit only intermittently. The change can be made very quickly, so that when receiving is done by a telephone this gives a clear note. The instrument giving the intermittent contact is called the "ticker." It may be a small electro-magnetic interrupter, or a cog-wheel with a sliding spring. It is important to note that the ticker methods in combination with the loose coupling of 2 per cent. or less, keep away the strongly damped oscillations of atmospheric or spark telegraphic origin.

The advantages of the new system are manifold. Instead of the noisy spark—and with large stations the noise is excessive—we have the quiet arc. The aerial may be the same as before. But from a large number of different stations will emanate electric waves of different lengths. The ether will oscillate in a symphony of electric tones, which will be led to their destinations with absolute certainty, and without interfering with each other. Tuning will be possible with a minimum difference of 1 per cent. only! Stations A and B may telegraph with 600 metres wave length and C and D, quite close by, with 606 metres. Mr. Poulsen has received from one aerial three telegrams at once, the difference of wave length being only 3 or 4 per cent. As the generator gives an electric spectrum ranging from 300 to 3,000 metres, the number of stations covering the same territory may amount to several hundreds.

Practical experiments have been made during the past 18 months, and the distance reached is several hundred miles over land. Mr. Poulsen is full of hope for the future, and the skill he has shown in what has been done is a guarantee of future success.

ILLUMINATIONS AT ABERDEEN.

During the Quater Centenary Celebrations held in September last, in connection with the extension of the Aberdeen University, electricity played an important part in turning night into festive day.

The illuminations, for details of which we are indebted to Mr. J. A. Bell, the City Electrical Engineer, were continued for the whole week of the celebrations, some £600 being spent by the department in accordance with the wishes of the Town Council. During the week the department sold for illumination purposes 10,574 units, of which 2,519 were for exterior illumination of buildings by private consumers, the remaining 8,055 being supplied to the Town Council for its illuminations. The Electricity Committee arranged to give this supply at 1½d. per unit, so that they only netted a matter of £55 for the 10,000 odd units supplied.

The Town Council illuminations took the form of (1) Outlining the municipal buildings; and (2) festooning Union Street.

The municipal buildings were outlined with 8 and 16-c.p. lamps, as shown in fig. 2, p. 778. Some 2,500 lamps were used on this work alone, the lamps being coloured red, white, blue, amber and green at the works before being installed.

On the west elevation of the tower, 150 ft. from the ground, a 24-in. searchlight was erected, which was worked in conjunction with another searchlight erected on the St. Nicholas Church Tower near by, the two being used principally to illuminate the masonry work of the new portion of the Marischal College buildings.

In connection with these searchlights an interesting type of resistance was used. The voltage of supply (220 volts) had to be reduced to about 47 volts at the lamp terminals. The resistance for this work consisted of 15 ft. of 15 gauge Beacon wire wound in a spiral of 1 in. diameter. The wire was then placed in a wooden box, 14 in. × 7 in. × 7 in. deep, which was then filled with water, a small stream of water falling in at one end while the overflow water escaped at the other. With this arrangement the pressure of 220 volts could be applied across the terminals with a lamp in circuit and with a current of 50 amperes flowing along the wire, the temperature of the water only rising a few degrees. This arrangement worked most satisfactorily for hours at a time with no attention other than turning on and off the water at the start and finish. The load on the Municipal Buildings, including the searchlight and illuminated crystals on the side of the building, amounted to 500 amperes at 220 volts.

The street illumination, fig. 1, was carried out in conjunction with the decoration scheme, and consisted of illuminating the whole of Union Street (4,000 ft.). Ordinarily this street is lighted by means of 36 arc lamps spaced 40 yards apart on alternate sides of the street, or 80 yards between every pillar on the same side of the street. Between these arc lamp pillars venetian masts 30 ft. high were erected at every 20 yards, and from the top of these, Fairyland strip with lamps spaced 1 yard apart was sus-

pended in festoons from pole to pole, with a dip of about 12 ft. in the centre of each festoon. The Fairyland strip used for this purpose, was covered with French moss by the employés of the electric lighting department, and the lamps were coloured and arranged in a similar order to those on the Town House. In connection with the covering of these 3,000 odd yards of strip with

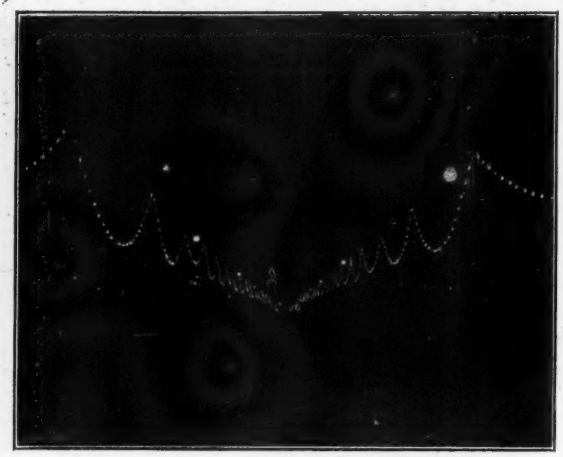


Fig. 1.—Illuminations in Union Street.

French moss, it might be mentioned that it took some eight men three weeks' ordinary working time to undertake this job, but the effect fully justified the labour put into it, as it made quite a tasteful day decoration, in addition to its use at night.

This arrangement of strip was fed at 28 points—namely, every 80 yards; the total number of lamps used was 2,360, and the current taken, approximately, 520 amperes at 220 volts.

In addition to the above, 26 flame arc lamps were erected in Broad Street and Union Street, in the vicinity of the University

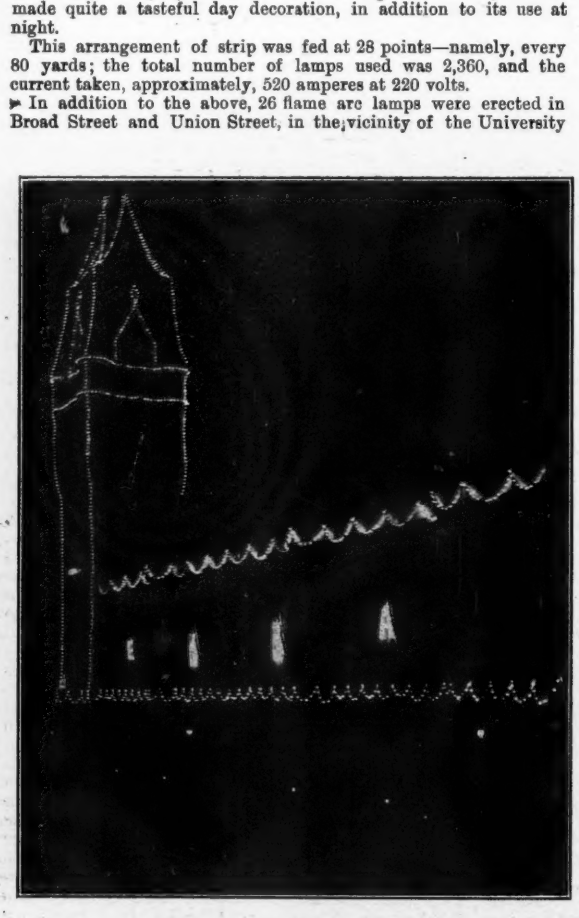


Fig. 2.—The Municipal Buildings Illuminated.

and Municipal Buildings. These, however, merely replaced the ordinary 10-ampere lamps usually employed.

There was also a considerable amount of temporary installations in connection with the University celebrations; one of the largest undertakings was the supply to the Strathcona Hall, this being the hall specially built by Lord Strathcona to dine at one time 2,500 University graduates and visitors. Here 800 16-c.p. lamps were used, with alternate lamps on different circuits, taking in all a current of 240 amperes at 220 volts. Two service cables, off separate networks, were taken into this building through throw-over switches, so that a supply could be taken from either section in the event of a fault in one.

The total number of lamps alight at Marischal College Buildings equalled an equivalent of 6,700 8-c.p. lamps, and as there were various functions during the week in these buildings, it meant a considerable additional load.

A great deal of private illumination was undertaken, as is shown by the consumption, and one of the prettiest effects was that obtained by the Harbour Commissioners in illuminating their new swing bridge between Victoria and Albert Docks with some 1,100 lamps, the whole of the girder and ironwork was outlined with 16-c.p. lamps, spaced 1 ft. apart, and arranged in colours of red, green and amber.

The Electricity Department purchased a considerable amount of material direct for this work, but in the case of Union Street, the whole of the Fairyland strip was hired from the Imperial Lighting Co., London.

PROCEEDINGS OF INSTITUTIONS.

High-Speed Electric Machinery: With Special Reference to Steam Turbine Machines.

By Prof. Silvanus P. Thompson, D.Sc., F.R.S.

(Abstract of Howard Lectures delivered before the Society of Arts, *January 18th and 25th, and February 1st, 1906, and published in the Journal of the Society.)*

(Continued from page 771.)

Turbo-Dynamos.

Because of the high speeds with which steam turbines run, it is impossible to avoid high peripheral speeds for the commutators. It has been generally considered hitherto that 3,000 ft. per minute is the highest speed at which a commutator will give satisfaction with carbon brushes. But if the turbine runs at 3,000 r.p.m., and the commutator is only 10 in. in diameter, the surface speed is already 7,854 ft. per minute. Moreover, at these high speeds, centrifugal forces become enormous, so that special means must be adopted for securing the conductors of the armature winding, and the segments of the commutator, from flying out. The former are usually secured by end caps of bronze, or by very heavy belts of binding wires. The segments of the commutator are held together by solid rings of self-hardening steel shrunk on over insulating rings of mica. The commutator is kept as small in diameter as possible; but as the segments cannot well be reduced in breadth below 0·25 in. at the surface, and as they usually number about 60 in two-pole machines, or from 100 to 120 in four-pole machines, the diameters usually run from 9 to 12 in. Further, in order to obtain sufficient contact surface for the brushes, the commutator must be made very long in proportion. Two shrunk-on steel rings, one at each end of the segment, and each of, say, 3 sq. in. cross-section are not even sufficient for such commutators; and it is usual to find an additional ring, or, in some cases, two additional rings, shrunk on at intermediate places. A commutator 18 or 20 in. long, and 10 in. in diameter, will have four such rings to hold it from flying apart.

Mr. Parsons, as far back as 1885, began to construct turbo-dynamos of small size, and has more recently designed a number of larger sets. For the Newcastle and District supply, Messrs. Parsons & Co. have furnished machines of 1,000 kw. at 1,800 r.p.m., working at 530 volts. These are four-pole machines. For the Manchester Corporation they have supplied machines of 1,800 kw., working at 460 volts. Each turbine drives two dynamos built on the same shaft. The reason for this practice, which is adopted by most of the makers of large units, is that, owing to the commutation difficulty, it has not been found expedient to construct the dynamos themselves of higher output than from 500 to 900 kw.

Messrs. Parsons have used metal brushes of stiff brass wire enclosed in gauze covers, pressed against the commutator by weights. To secure a better bedding of the brushes, they at one time formed the commutators with corrugated outline, the brushes lying in circular depressions turned in the periphery. In their earlier types they devised a most ingenious mechanism to rock the brushes forward automatically by steam pressure according to the load on the machine. More recently they have adopted a compensating winding without any special commutating tooth (Patent No. 12,408 of 1903); and with the adoption of this plan it has been found possible to fix the brushes once for all.

Messrs. Brown, Boveri & Co., who have taken up the Parsons patents on the Continent, have made many turbine sets. In the case of the field-magnets of a four-pole 125-kw. dynamo, for driving at 3,000 r.p.m., each of the four poles is slotted with five slots. Of these the centre one is left empty, while the other four receive the compensating windings. Between the four poles are four narrow projecting teeth which serve as auxiliary commutating poles. Wide slots on each side of the tooth are left to receive the shunt winding. The frame is arranged with a view to ventilation, with air channels that lead up into two short chimneys at the top. For a two-pole machine of the same size, the principal poles, right and left, have each 12 slots to receive a distributed compensating winding. There is a commutating tooth at the top and at the bottom. The shunt windings fill the wider slots; and means for anchoring the end-bends are afforded by steel bolts, which project at the sides. It is

impossible to do justice in the compass of a short notice to the varied machines which Messrs. Brown, Boveri & Co. have designed. From July, 1903, to September, 1905, this firm constructed turbo-generators having a total output of 25,000 H.P.

The Siemens-Schuckert works, of Berlin, have adopted the Zoelly turbine, and construct turbo-dynamos in numerous types. The end-bends of the armature windings are covered by metal casings, which, in the latest machines, cover the risers also at the anterior end so as to prevent copper dust from the commutator from penetrating into the interior. The commutator shrunk-on rings, in the latest machines, are insulated at the flanks to prevent flashes of sparks along them. Carbon brushes are used along with metal ones. According to researches made by the Siemens-Schuckert works, carbon brushes can be used up to 6,000 ft. per minute. All their continuous-current turbo-dynamos are provided with auxiliary poles. Ventilating housings are used for all machines.

The Brush Electrical Engineering Co. manufactures turbo-dynamos under licence from the Parsons Co., with a compensating winding to neutralise distortion, and another winding on auxiliary commutating poles. Wire gauze brushes are used, pressed against the commutator by balanced counter-weights. The position of the brushes when once adjusted remains fixed, so that no rocking gear is required. The armature conductors are laid in slots and secured by wedges. There are no binding wires, the end connectors being covered by manganese-bronze caps.

The Oerlikon Machine Works, of Zurich, have developed steam-turbine machines of many types. Of those for continuous-current supply two examples may be cited. Figs. 8 and 9 depict a 150-KW. bipolar dynamo, for 3,000 R.P.M., designed two years ago, to give 650 amperes at 230-250 volts. The diameter of the armature core is 17·8 in., the core length 19·7 in., the width of air-gap 0·296 in. The armature has 60 slots with two conductors per slot, and the number of commutator segments is 60. The diameter of the commutator is 10·4 in., the gross length of the segments about 16 in., and the available working length between the shrunk-on rings about 8 in. The peripheral speed of the armature is 14,000 ft. per minute; that of the commutator 8,100 ft. per minute. The specific loading is 700 amperes per inch. As fig. 8 shows, there is a distributive compensating winding as well as auxiliary poles. Fig. 10, p. 780, is a scale drawing of a quite recent turbo-dynamo of the same firm, a four-pole machine of 200 KW. at 3,000 R.P.M. to give 800 amperes at 250 volts. Other data are given below. The armature is lap-wound, with equalising connectors. As will be seen from the drawing, there is no compensating winding, magnetic distortion being minimised by making the pole-arc small, and by reducing the cross-section of the pole-cores so as to obtain high saturation. There are four auxiliary poles for commutation, and these are each excited by an auxiliary winding of 11 turns of copper strip, 6 in. wide and 0·136 in. thick.

Comparison of Turbo-Dynamos with Slow-speed Dynamos.—The Oerlikon turbo-dynamo just described, of 200 KW. at 3,000 R.P.M., is here compared with a six-pole dynamo of 200 KW. at 135 R.P.M., being a machine described on p. 190 of Parshall and Hobart's "Electric Generators." The machines differ in that the high-speed machine is for 250 volts, while the low-speed machine is for 500 volts.

Machine A (Oerlikon) M.P.T. 4-200-3,000.
Machine B (Parshall) M.P. 6-200-135.
The dimensions are in inch units.

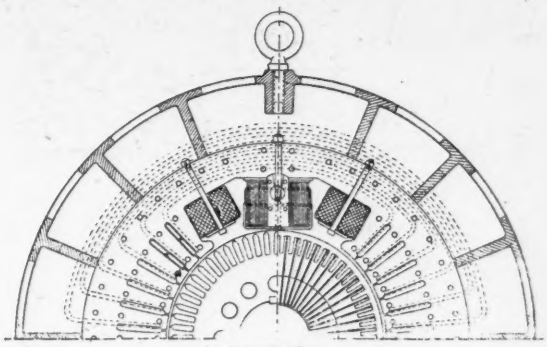
	A	B
Diameter armature core	22·02	59·25
Length (gross) armature core	17	14·25
Number of air-ducts...	5	5
Net length of iron in core	14·3	9·9
Number of slots in armature	100	220
Conductors per slot	2	8
Total number of conductors	200	1,760
Width of air-gap	0·590	0·33
Outside diameter of yoke	45·7	112·5
Equivalent pole-span	7·1	23·1
Pole-pitch	17·325	31·2
Diameter of commutator	10·25	39
Length, gross, of commutator	22·5	9
Working length of commutator	13·4	6·75
Number of segments...	100	400
Width of segment at face	0·322	0·240
Calculated Data and Coefficients.		
Steinmetz coefficient...	1·87	4·2
Esson coefficient	124,000	35,000
Peripheral speed (ft. per minute)	17,300	2,100
Amperes per in. periphery	576	616
Flux per pole	2,500,000	13,300,000
Flux density in gap	20,600	45,000
Pole span ÷ pole pitch	0·46	0·74
Commutator diameter ÷ armature diameter	0·48	0·66
Peripheral speed of commutator	8,350	1,400
Centrifugal force at armature surface (pounds per lb.)...	1,406	8·6
Centrifugal force at commutator	640	5·8
Stiffness ratio...	125	49
Commutation figure of merit *f*	2·81	2·92

Little has been said above as to the question of temperature rise, for, as a matter of fact, in continuous-current machines the limit of output, if ordinary regard has been paid to ventilation, is set not by the temperature rise, but by the commutation question.

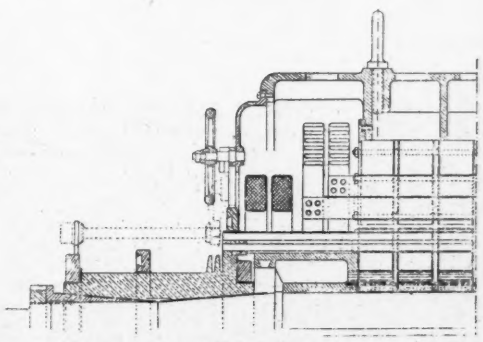
Improvements in Carbon Brushes.

The difficulty of applying carbon brushes to turbo-dynamos lies in the high surface speeds of the commutators. Ordinary carbons on such commutators are not satisfactory, because if used with ordinary pressures (such as 1·5 to 2 lb. per sq. in.) they are apt to chatter if there is the slightest inequality of periphery. However light they are made, their inertia does not permit them at speeds of 2,000 or 3,000 R.P.M. to follow the inequality of surface. And if, to prevent chattering, higher pressures are applied, then there is further trouble, for a soft carbon will smear the commutator, and a hard carbon will score it into ridges, and in either case there will be excessive heating. Messrs. Parsons state that they have never found carbon brushes satisfactory except on one small and slow-speed machine. Messrs. Siemens-Schuckert, on the other hand, use mixed arrangements, of a few carbon brushes along with a majority of metal brushes.

Recently, however, the carbon manufacturers have bestirred themselves to produce special qualities of carbon brush suitable for use with high speeds. Foremost amongst these is the Morgan Crucible Co., of Battersea, who have introduced in their manufacture several novel features. In the first place, all their brushes are made with an invisible grain in the longitudinal direction, which



Cross-Section.



Longitudinal Section.

Figs. 8 and 9.—Oerlikon 150-KW. Turbo-Dynamo, with Auxiliary Poles and Compensating Coils.

results in their having a low conductivity laterally, and a much higher conductivity longitudinally. This feature of stratification tends to reduce parasitic currents within the brush and to lessen the heating. The friction coefficient is also low. Another type, known as "link-two" carbon, has the peculiarity that the longitudinal resistance is higher at one side than at the other, and of intermediate values between. Hence such brushes are of particular value for machines running in one direction only, the edge of higher resistance being the edge where the last contact is made; for if the carbon at the toe of the brush is of higher resistance, the presence of a higher resistance at this part will tend to diminish the current that is dying out, while the lower resistance at the heel will tend to augment the current that is increasing, so helping the completion of the process of commutation. The reduction of resistance in one side of the brush is facilitated by the introduction into the carbon, during manufacture, of finely divided copper. Messrs. Morgan have had Morganite brushes for some months upon a Parsons bipolar turbo-dynamo at their works. This is a 90-KW. machine designed seven years ago, giving 650 amperes at 115 volts, running at 3,530 R.P.M. The commutator, which is 8 in. in diameter, and has only 30 segments, is 10 in. in useful length. It was designed for metal brushes, the peripheral speed being 7,068 ft. per minute. To this machine Messrs. Morgan adapted their special carbon brushes, with a pneumatic brush-holder that keeps the brushes in contact with a minimum of inertia. The machine had no compensating winding, and was not intended to be used with the brushes in any fixed position. In fact, with metal brushes it was necessary at full load to give the brushes a lead some 3 in. in advance of their position at no load. But with the carbon brushes sparkless commutation was obtained with a fixed position of brushes between quarter-load and an overload of 5 per cent. Morganite brushes are also used in ordinary holders on turbo-dynamos by Messrs. Siemens Bros., at Manchester and Glasgow; and Messrs. Brown, Boveri & Co. are also using them on their

turbo-generators, such brushes being set on the brush pillar in front of a gauze brush.

Further experience is, of course, necessary with these brushes to ascertain whether they possess the necessary mechanical qualities to last for long periods.

Homopolar Dynamos.

There is yet one other way of getting over the commutation difficulty; and that is to have no commutation at all. Ever since Faraday's primitive disk-dynamo of 1831, the designers of electric machines have been haunted by the possibility of constructing a machine of the so-called "Unipolar," or rather *homopolar* type, with sliding contacts and no commutator. The peculiarity of such machines, if made for ordinary speeds, is their very low voltage, an inherent fault of low speed. But with the advent of steam turbines, and the possibility of using enormous surface speeds, the old difficulty seems likely to disappear. It is possible now for a

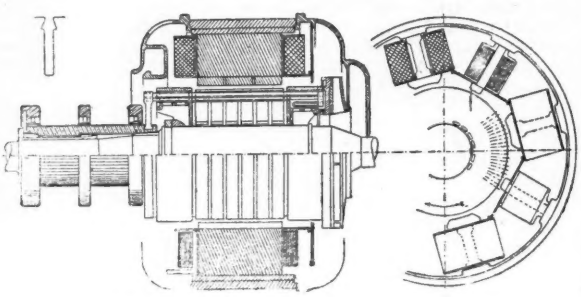


Fig. 10.—Oerlikon 200-kw. Turbo-dynamo.

moving conductor to generate 1 volt per in. of its length, instead of requiring as was formerly the case some 6 or 7 in. per volt. So unless unforeseen difficulties should arise in collecting the current from a sliding surface at such speeds, machines on this plan will be entirely practical.

In fact, two of the leading firms have constructed homopolar dynamos—the General Electric Co., of Schenectady, from the designs of Mr. Noeggerath; the British Westinghouse Co., from the designs of Mr. Miles Walker. Mr. Noeggerath's machine, known as an acyclic generator, is of 300 kw., working at 500 volts, driven by a Curtis turbine of vertical pattern. The revolving cylinder is built up of 24 smooth conductors, held by steel binding wires, each conductor terminating in a steel slip-ring; and connection is made from the slip-rings at one end to those at the other by means of copper brushes, so that all the conductors are united in series. Experiments have shown that the contact voltage developed at each contact increases with the current density. As might be expected, this voltage, when the surfaces are stationary, is nearly proportional to the density; and it amounts to less than 0·4 volt for a current density of 1,000 amperes per sq. in. When running at a surface speed of 10,000 ft. per minute, the contact voltage rises with the current density from about 0·2 volt when the density is small to about 0·8 volt for a density of 1,000 amperes per sq. in. At speeds above 7,500 ft. per minute, with copper brushes on steel collecting rings, the losses become nearly constant, and the temperature goes down. All this is most satisfactory, as it demonstrates the entire practicability of this type of machine.

The homopolar dynamo, designed by Mr. Miles Walker, is built as an exciter for a turbo-alternator, and consists practically in an iron cylinder revolving in a uniform radial field. It generates current at 10 volts only, the current being passed along the shaft to the circuits of the field-magnet of the alternator. Extreme solidity and simplicity characterise this machine. Its field-magnets are separately excited. It is at present impossible to foresee to what fresh developments these important departures may lead.

(To be continued.)

Indoor Illuminants.

By James Swinburne, F.R.S., M.Inst.C.E.

(*Abstract of Paper read before the* Association of Engineers-in-Charge, *November 14th*, 1906.)

If we study a system of, say, gas production and distribution, we find at one end a most elaborate plant for manufacture in which each part is carefully suited to the end in view, and is calculated to give the results desired with the greatest possible efficiency and economy. But what do consumers do with their gas? They just set light to it and let it burn away, and are quite content if they get a little light, until the account comes in. Then they sometimes grumble.

It is just the same with electric light. A modern central station is a marvellous study of economical production. There is no industry in which costs are so carefully examined, or so accurately worked out. But all questions of economy end at the consumer's meter. He uses blackened lamps, which are marked incorrectly to begin with, and he covers every light with useless and dirty shades, and has his lamps in the wrong places.

It is not that the supply companies take no interest in the matter after their product has passed the meter; quite the reverse, they are most solicitous for the welfare of their customers. The gas people, for instance, do their level best to persuade their consumers to use the best burners, or to employ mantles and get the best results. It is just the same with electric light; it pays the companies if the consumers use good and economical lamps. They will finally want more light rather than smaller payments, and the total supply will go up.

It is exceedingly difficult to educate the consumer. The average man is busy all day, and you cannot expect him to spend his evening puzzling out questions of photometry or luminous efficiency. But among engineers-in-charge it is quite worth the while of the man who has to look after the lighting of a big building to become a specialist to some extent in illumination. Some day we may have illuminating engineers who are not supply electricians or gas engineers, but concern themselves with the application of electrical power, gas, petroleum and acetylene to lighting, dealing with each on its merits without partiality. At present the question is left generally to architects, house decorators, and chance, and chance has far the most to say in the matter.

In all cases the important point is that the eye should receive plenty of diffused light from the objects that are to be observed, and as little light as possible from any other surfaces. The last part of this is most frequently overlooked in lighting a building. The eye is something like a photographic camera provided with a portrait lens with a very large circle of illumination. It is, therefore, somewhat difficult to arrange lights so that they do not shine into the eye. The eye is shaded above by the eyebrows, however, and this makes the problem easier to solve.

What happens in the case of the eye is that it finds it is getting more light than it likes, so that it automatically closes its iris diaphragm. A much more serious matter is that if a strong light comes into the eye at all, the eye is automatically turned to look at it, so that the image is formed on the most sensitive part of the retina. This produces two results; the iris is automatically closed, and the retina becomes fatigued, or the eye is dazzled; and the sensitiveness is lost until the eye gradually recovers it. It is, therefore, most important that the eye should not be exposed to bright lights. It would be almost impossible to light a public or any other building economically entirely by diffused light, with all the lamps out of sight; but the evil of direct lighting can be very much reduced by arranging lamps so that they are high enough not to shine directly into the eye, except from a good distance, and so that they are small as to candle-power, and large in area, and give diffused light. From a physiological point of view, therefore, the sources of light should not be intense, but should be small and numerous, or should be out of sight.

There is another very important question, and that is—What colour should the light be? There is a very general idea that the light which suits the eye best is yellow. It seems probable that, as the eye is a result of evolution, the eye is best suited for daylight, and therefore daylight is best suited for the eye. It seems, therefore, safe to assume that the yellow of most artificial lights is not a good colour, and that artificial light should be as near sunlight (as it reaches the earth) as possible. This view is supported by the experience of users of the mercury arc. This gives a greenish light, which is very actinic, and it was generally supposed that it would be very unpleasant for the eyes. It is found, however, that though it makes things look very ugly, as far as colour goes, it is very restful to the eye, and is specially useful in drawing offices and such places.

Another reason why we should try to make artificial light approach daylight as clearly as possible is, that it is necessary if we want to distinguish colours properly. For some business purposes it is quite necessary to be able to judge colours and to match them. There is only one case in which yellow light is an advantage, and that is for drawing rooms and ballrooms and public places where ladies are in elaborate dresses, and are therefore specially anxious to look as well as possible.

We may divide the illumination of buildings into two classes, general and special.

Lighting desks and tables for reading or writing is the commonest case of special lighting. In both cases what is required is plenty of light on the paper, the source being in such a position as to be itself invisible. This is easily arranged by having the lamp rather behind the reader, and on the left side in addition in writing, so that the shadow of the pen will not give trouble. A small light close to one is much pleasanter for writing than a number of lamps at some distance, as they make a pen work in the centre of a number of radial shadows, which is very annoying. Writing is generally confined to fixed positions, so it is not difficult to provide good lighting; but such places as reading rooms are more difficult. Probably the best plan is to have plenty of light coming downwards from near the ceiling, so that the lamps do not shine into the eye. The lights should not be so few that a dark shadow of one's head is thrown on the book or paper.

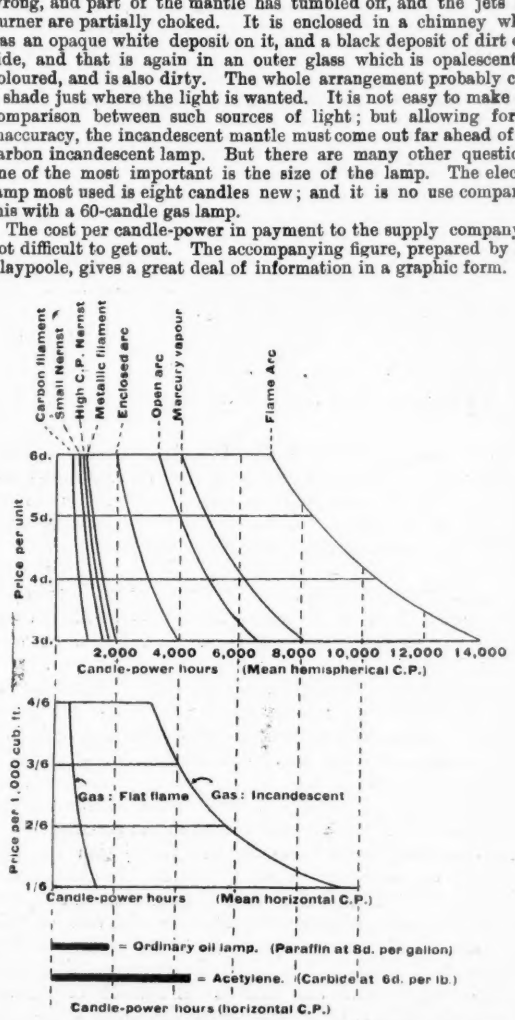
Such special cases as shops or warehouses in which colours have to be matched, do not need special discussion, as the chief point is to choose sources of light which give something as near daylight as possible. The walls should be pure white. If they are light in colour, they return a good deal of the light that falls on them; but if they are coloured they return coloured light, so that a room with yellow walls will have yellow light, though the source of light may be the sun itself.

In the case of general lighting, for instance, of a dining room, a ball room, or a town hall, I would again suggest that the really important point is to arrange the lamps so that they do not trouble the eye and cause the iris to close automatically or tire the retina. We are all far too intent on getting the greatest candle-power at a given expense. It is no good having 10,000 c.p. in a large room.

if you can really see better with 1,000 properly arranged. Another point in this connection we nearly always overlook, or we underrate its importance: and that is, colour of walls and hangings. Suppose a large room has a number of small lamps distributed in it, and suppose the walls are quite black, anything in the room is lighted by the lamps directly, and gets no light from the walls. Now suppose the walls are re-papered so as to have a surface which only absorbs half the light that falls upon them; this helps the lamps to such an extent that they can give twice the illumination.

It is very difficult to make any useful comparison of the costs of various illuminants, as each has special advantages and drawbacks. In the old days we used to compare the electric lamp giving about a third of a candle per watt with a flat-flame burner giving two candles per cubic foot; and it was usual to assume that the gas was left on longer through carelessness and difficulties of lighting. Now it is more usual to compare the electric lamp, giving about a quarter of a candle per watt and lasting a short time, with incandescent mantles giving 20 candles per cubic foot and lasting for ever. Now the fact is, that the average electric incandescent lamp in use in this country was badly graded to start with, and has been run until it is black. Its bulb is also dirty, and it is inside a dirty shade which cuts off a large percentage of any light that has been fortunate enough to get so far. The incandescent mantle, on the other hand, may have been capable of giving 20 candles per cubic foot to begin with, and it has gone down considerably, and it is on a burner with the gas pressure wrong, and part of the mantle has tumbled off, and the jets and burner are partially choked. It is enclosed in a chimney which has an opaque white deposit on it, and a black deposit of dirt outside, and that is again in an outer glass which is opalescent or coloured, and is also dirty. The whole arrangement probably casts a shade just where the light is wanted. It is not easy to make any comparison between such sources of light; but allowing for all inaccuracy, the incandescent mantle must come out far ahead of the carbon incandescent lamp. But there are many other questions; one of the most important is the size of the lamp. The electric lamp most used is eight candles new; and it is no use comparing this with a 60-candle gas lamp.

The cost per candle-power in payment to the supply company is not difficult to get out. The accompanying figure, prepared by Mr. Claypoole, gives a great deal of information in a graphic form.



Candle-power-Hours obtained for One Shilling from Different Illuminants.

It tells you how many candle-power-hours you can get for 1s. from various illuminants. Thus, if electrical energy is at 5d. per unit, a carbon filament will give you, roughly, 500 c.p.-hours, say, 10 candles for 50 hours for 1s. paid to the supply company. If the electrical energy is 3d. per unit, as at the bottom of the diagram, 1s. worth of energy will give you 2,000 candle-hours with a metallic filament lamp, say, 20 candles for 100 hours; or with a mercury vapour lamp you can get 8,000 candle-hours, or, say, 100 candles for 80 hours. A flame arc at 4d. per unit, again, gives 10,500 candle-hours for 1s.; or, say, 1,050 candles for 10 hours.

Turning to the gas diagram below, you find that if gas is at, say, 1s. 6d., a flat flame burner gives about 1,400 candles for 1s., and so on. The incandescent burner, however, gives over 3,000 candle-hours for 1s. at 4s. 6d., that is to say, on the top line. This might be, for example, 60 candles for 50 hours. At 3s. 6d. it gives about 4,000, and so on. Oil lamps have been taken for one price of oil only, 8d. a gallon, and acetylene with carbide at 6d. per lb.

These figures take no account of the costs of renewals of electric lamps or mantles, or of trimming and providing globes for arc lamps. They, therefore, do not really give a comparison of the costs. Moreover, the lamps and mantles are taken as new. All the same the figures are very instructive. It will be seen that oil lamps are much cheaper than either ordinary electric carbon lamps or gas with ordinary burners; and acetylene is astonishingly cheap.

Each illuminant has, however, its own special advantages and drawbacks.

By far the most important illuminants from this society's point of view are gas and the electric light. As far as cost of gas and electrical energy go it is not difficult to compare the rivals, but it is much more difficult to compare the cost per candle-hour including lamps and mantles and incidental expenses.

We need hardly consider the ordinary flat-flame burner now, though it is still very generally used; in the same way we might almost put the carbon lamp on one side, because it appears to be doomed, as the metal wire lamps seem bound to push it out of existence as soon as they can be made in large enough quantities, and what is more important, as soon as the public get into the habit of asking for them. The metal lamps are far more efficient than the carbon, but they have some special drawbacks of their own. Some do not work well on alternating circuits. This is a difficulty that exists in some lamps only, and will most likely soon be overcome. The other and very serious difficulty is that it is apparently impossible to make small lamps for reasonably high pressures.

One of the great advantages the carbon lamp had over the mantle was that it could be made very much smaller without loss of efficiency. If you only wanted three candles to light a passage, for instance, it was no use having a 50-candle gas lamp unless the 50 candles cost as little as the 3-candle electric lamp. Again, in lighting a large room a number of small lamps is better than a few large burners. But in cases where the question of small lamps does not come up the mantle seems to be much more economical.

It is thus impossible to get any sort of clear idea as to the relative prices of lighting by electricity or gas. Broadly, we may say that gas lighting with mantles is very much cheaper than any form of indoor electric light except the mercury lamp. There are other questions, however. One is that of health. Gas uses up the air. This is a matter of great importance, especially in towns. It is not generally known that rooms are ventilated a good deal through the walls. In towns the living rooms are more closely occupied, and have less outside wall; it is thus more important that the gas should not use up the air. Incandescent gas of course uses much less air in proportion to the light than the old flat-flame burner; but even thus, compared with human beings, the air used is a very serious consideration. As to sulphur, I would suggest that gas has been rather maligned. Sulphur dioxide is exceedingly bad for plants, but it is not necessarily so for animals. No doubt it is deleterious, however, but the probability is that each of us breathes a hundred times as much sulphur dioxide from burnt coal as from gas. Gas is maligned perhaps in another direction, the destruction of book bindings. According to "Leather for Libraries," the products of combustion of gas are not responsible for the destruction of leather bindings. At the same time it is difficult to believe a high temperature alone is not enough to injure books. Anyone who has not gone up steps to the top shelves of a gas-lighted library will be astonished at the high temperature to be found there.

There is another consideration as well as that of light, and that is, the convenience of gas and electric supply for other purposes, such as power and heating. For distribution of power in small quantities, of course the electric motor is supreme; though for what would be large powers in domestic use the gas engine comes in. In heating neither would appear to have a chance against coal; but gas has many very great advantages. Just as gas heating can replace fires, electric heating can in some cases replace gas. One cannot help feeling that this is largely the fault of the gas engineer. It seems to have been the idea of the original makers of gas fires that a Bunsen burner got more heat out of the gas than the ordinary flame; and the result is that most heating and cooking stoves have Bunsen burners. Though a Bunsen may burn perfectly alone, if you put a kettle on, it seems at once to have the combustion checked and to give off bad gases, probably carbon monoxide. Now nearly all the boiling burners on cooking stoves are of the Bunsen type. Nine-tenths of the heating stoves for living rooms have Bunsen burners whose flames are choked with asbestos or iron radiators. The fumes then escape partly into the room even when there is no down-draught in the chimney. Anyone who values his health should never use a Bunsen flame gas stove without making sure that no Bunsen fumes come into the room. The gas stove might learn something from the electric stove. The object of a stove is not to heat the air that is in contact with it, but to radiate the heat. The electric stove radiates most of its heat, and this gives it just where it is wanted, and is, therefore, useful in spite of its ridiculously low efficiency. The gas stove, on the other hand, is not made with any intelligent comprehension of radiation.

Gas and electric light are by no means the only kinds of illuminant that concern us. In many cases acetylene is specially suitable. Acetylene does not seem to have been as successful as it deserves.

Acetylene is cheap taken in candle-hours per shillings-worth of carbide, but of course the generator needs attention, and the foul lime has to be got rid of somehow. In places where there is neither electric nor gas supply there is a great opening for acetylene.

Carburetted air gas is another claimant for favour. In the "National Air Gas" system the air takes up about ½ per cent. of

hydro-carbon, and it is used for the incandescent mantle. The company claim that with cheap petroleum at 8d. a gallon, their system gives 1,000 candle-hours for ½d., or 24,000 candle-hours for 1s. This would be right off the diagram, and would be less than half the price of the light of the flame arc. I have no knowledge of this system myself, I have merely taken these figures as given to me; but they are good enough to warrant our giving this system very careful attention.

Physical Society.

At the meeting held October 26th, 1906, Prof. J. Perry, F.R.S., president, in the chair, a paper on "The Strength and Behaviour of Ductile Materials under Combined Stress" was read by Mr. W. A. Scoble.

A paper by Mr. J. M. Baldwin on "The Behaviour of Iron under Weak Periodic Magnetising Forces" was read by Prof. F. T. Trouton. The principal points brought out by Mr. Baldwin's work are as follows:—(1) The permeability satisfies a linear law through a considerable range for weak fields, diminishing to a minimum about 150 as the amplitude of the field diminishes; (2) as the field diminishes the difference in phase between the induction and the magnetising force tends to disappear; and (3) at the same time the hysteresis losses become very small; (4) frequency at these low values of the field has practically no influence on the results obtained.

A paper by Prof. R. W. Wood on "Fluorescence and Magnetic Rotation Spectra of Sodium Vapour and their Analysis," was taken as read.

Institution of Electrical Engineers.

The opening meeting of the Session was held on Thursday, 8th inst., at the Institution of Civil Engineers, Great George Street, when Dr. R. T. Glazebrook delivered his presidential address, which readers will find discussed at some length in our leader columns.

During the evening the following awards were announced in connection with last year's proceedings:—The Institution premium, value £25, to V. A. Fynn; the Paris Electrical Exhibition premium, value £20, to Prof. A. Schwartz and W. H. N. James; an extra premium, value £10, to H. T. Harrison, to W. J. A. London, to Dr. D. K. Morris and G. A. Lister, and to R. N. Tweedy and H. Dudgeon; an original communication premium, value £10, to Dr. W. E. Sumpner; the first students' premium, value £10, to A. G. Ellis; the second students' premium, value £8, to H. W. Taylor; the third students' premium, value £5, to F. C. Prentice and J. S. Westerdale; an extra premium, value £5, to W. Browning; Salomon's scholarship, value £50, to R. C. Jakeman; David Hughes scholarship, value £50, to A. Kinnes and G. F. O'Dell.

LEGAL.

London Electrobus Co.

In the Chancery Division of the High Court on Friday before Mr. Justice Warrington.

Counsel, on behalf of the London Electrobus Co., applied for leave to rectify the register by striking off the names of 41 additional shareholders, who had applied to have their names removed from it. On June 28th last an order was made by Mr. Justice Buckley striking off the names of 1,026 of the shareholders *ex parte* in order to save expense, and the present application was made *ex parte* for the same reason. The additional shareholders who now applied to have their names removed had either been overlooked on the last occasion, or had not then made application.

His Lordship made the order asked for.

CORRESPONDENCE.

Letters received by us after* 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Application of Magnetic Brakes.

Col. Yorke's report on the Highgate accident is a very interesting and practical document, and your able leader on this subject in last week's issue includes some valuable suggestions with regard to this report and the question of safe working generally. Your support of the necessity of some alternative or emergency brake of a simple design, requiring but an elementary motion on the part of the driver, is one with which I am in full agreement.

I was unable to be present at the discussion on Mr. Mozley's paper regarding brakes at the Municipal Tramways Conference, but I contributed some notes, and, as they have not been published with the recent account of the proceedings, I enclose copy herewith.

There is no doubt that many of the details of brake gear require improving in the manner suggested by Col. Yorke, but in the controlling of cars on steep inclines, I am of the opinion that placing absolute reliance on one brake—be it the mechanical slipper, magnetic track, air or regenerative control brake—will undoubtedly from time to time lead to disaster, as failure of the brake gear or of the personal element must, in the ordinary course of things, occasionally occur.

The recent suggestions in your "Correspondence" columns for the further improvement of the magnetic brake are undoubtedly valuable ones, but must tend slightly further to complicate matters, and only give an alternative in the event of failure of one method of applying the brake, without providing for any breakdown in the brake mechanism itself.

Mr. Fell's suggestion to apply screw control to the magnetic slipper brake is again a most useful one, but when dealing with severe inclines, can it be made sufficiently quick in application to deal with a car after it is found to be out of control from the failure of the electro-magnetic brake? It is questionable whether the speed attained by the time the emergency screw track brake was applied would not be such that this form of brake could not regain control of the car.

In your leader you emphasise the importance of having some alternative brake entirely independent of any other. This I consider most desirable, and it is for this reason that the suggestions referred to above for improving the present design of brakes only partially solve the problem. As a further safeguard in the event of failure of the personal element, such alternative brake should be under the control of the conductor as well as the driver.

P. J. Pringle.

Electricity and Tramways Department,
Burton-on-Trent, *November 8th*, 1906.

[In the notes referred to, Mr. Pringle raises the question whether, in the recent cases of failure of brakes, the cars concerned were equipped with an effective alternative brake, independent of the brake usually used, if possible more effective than the latter, and capable of being applied without complications to worry the driver. He considers that an electric brake of any form is not always an effective stand-by when combined with the usual hand brake. Mr. Pringle therefore holds the same views that we have put forward independently.

For emergency use, there is no necessity whatever for the brake to be elaborate, or for it to be capable of repeated application. The supreme necessity is to stop the car, and if the brake, having saved the car and passengers from destruction, be itself destroyed in the act, no worse consequence will follow than that the car will be regarded as for the time disabled, and will have to pay a visit to the car-shed.

An emergency brake answering this description has been employed on a French tramway, where the gradients are excessive. This consisted of a stout wooden balk, supported in guides nearly vertically under the car. In case of need, this could be released, the lower end falling on the roadway, and the angle of the guides being suitably chosen, the motion of the car itself drove the balk into the surface of the road. As a matter of fact, in the case cited, the lower end of the balk was furnished with iron dogs, which buried themselves in a plank provided in the roadway, and thus increased the retarding force; but possibly this might be dispensed with. —Eds. E.R.]

The following further remarks to my previous letters on the above subject may be of interest. In your able leader of November 2nd and the further remarks in November 9th issue, on Col. Yorke's Board of Trade report on the Highgate tram disaster, one of the points you discuss is that gentleman's advocacy of an improved screw hand-brake, and you remark, and rightly so, that it is unnecessary to increase the leverage by which the motorman can apply the hand-

brake. This is already sufficient. The real point of the matter is that it would provide *a positive release equal or greater in magnitude of power to the application*, a condition which no present system of hand-braking supplies. The starting point of most tramway disasters has been the jamming of the hand-brake, followed by the more or less frantic endeavours on the part of the motorman to unlock the wheels. A positive screw release would, in many cases, have effected this, and this I think is Col. Yorke's attitude on the matter, which appears to have been little mentioned by you in your comments.

Col. Yorke's remarks greatly support and strengthen my attitude towards automatic control of magnetic track brakes, and I feel sure that automatic excitation from the trolley wire will be one of the means of decreasing the number of accidents in the future.

Let us consider one or two extreme contingencies under which the automatic brake would be placed, as it is only by taking the most *unfavourable* conditions under which a certain device is supposed to work, that we can attain any true perspective. The favourable conditions will look after themselves.

1. Down gradient: car skidding with locked wheels; excitation from trolley wire through high-resistance winding of brake.

2. Down gradient: wheels revolving; temporary failure of supply through circuit-breaker opening or other cause; motor-braking circuit already cut in, not dependent on supply.

3. Same conditions as (2), but trolley de-wired; same result.

4. Down gradient: car skidding; failure of supply or trolley de-wired; automatic no good; non-magnetic track brake good in this contingency; if fitted with magnetic, two things can arrest the progress of the car—(*a*) Providence; (*b*) obstacles.

Assuming that (*a*) has a low working efficiency, we must look to (*b*).

A convenient motor-'bus is a suitable obstacle, and several portly passengers enhance the value of such obstacle. In the process they become mere inanimate protoplasm, but the chief end is attained. The car is stopped.

To this popular method of stopping runaway cars there are two principal classes of objectors:—(*c*) The directors of the 'bus company; (*d*) the said portly passengers (*alter ego*).

5. Car leaves the rails; trolley de-wired. Owing to the diamagnetic nature of cobble stones and macadam, magnetic brakes of little use save as a rheostatic circuit.

6. Car overturns: magnetic brakes little use. Value of μ for air 1.

The treatment of wheel friction electro-magnetically, and the only known method of increasing the friction between steel and steel or chilled iron, sanding of course being obviously of a different nature, will become an important factor in the prevention of skidding when braking.

Alfred V. Newell.

Manchester, *November 12th*, 1906.

Bullock Motor Control System.

In reply to queries by "Bullock," page 743 current issue—

1. The diagram is, roughly, as follows:—

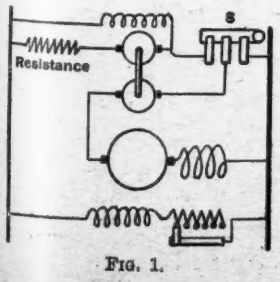


Fig. 1.

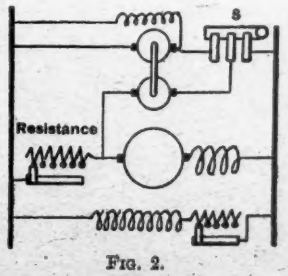


Fig. 2.

2 (*a*). Main driving motor compound-wound, series winding assisting shunt.

(*b*). Armature circuit at slow speed is supplied with current at low voltage from teaser, and at high speed direct from the line.

3. Main driving motor is fully excited at slow speeds both by series and shunt winding.

4. Shunt regulating resistance is not in circuit at slow speeds, but is introduced after all the armature regulating resistance has been cut out.

The main driving motor is directly geared to the press, and supplied with current for every movement of the press, though not solely from an auxiliary apparatus, the latter consisting of a motor and a generator, either as two distinct machines or as one machine with a double-wound armature and two commutators. This motor-transformer is only used for supplying current to the main motor for starting, "inching" and "leading-in" movements.

The main motor and the motor part of the transformer are both wound for the line voltage, whereas the generator part of the transformer is wound for about 15 per cent. of the line voltage, though capable of generating the abnormally large current required by the main motor to develop the necessary starting torque, which may reach 50 per cent. or 60 per cent. above the full-load full-speed current. The watts, however drawn from the line for this duty, may be only 30 per cent. to 40 per cent. of the full-load watts.

On closing circuit, current from the line traverses the fields of both transformer and main motor, also the transformer motor armature with a resistance in circuit, see fig. 1. The transformer dynamo then generates the heavy current required by the main motor. As the resistance in the transformer circuit is cut out, the speed of the latter rises, the transformer dynamo voltage rises proportionately, and the main motor speeds up under perfectly steady control. For higher speeds the line current is supplied to the main motor armature through a regulating resistance, fig. 2. As this resistance is gradually cut out, the voltage to the main motor from the line will exceed the voltage from the transformer dynamo; thus more current will be also drawn from the line and less from the dynamo, until the transformer ceases to generate, and is automatically cut out of circuit by the opening of switch S. The speed of the main motor is regulated up and down by armature and field resistance.

W. A. Clatworthy.

Newcastle, *November 12th*, 1906.

Rail Corrugations.

I have just come across a short length of rail about 12 ft. long which shows some remarkably well defined vertical corrugations or buckles in its web. They are very regular, and their depth is about $\frac{3}{16}$ in. and pitch $2\frac{1}{2}$ in. This rail has never been laid in the ground, but was part of a stack left over when the system was first laid down.

It appears to me that this may be a very exaggerated case of what occurs in a great many rails in a much less degree (in a degree, in fact, which is too small to be observed with the eye or touch, but which is, nevertheless, there), and if there is such a state of things in the web of the rail, surely it would in course of time make itself evident on the head of the rail which it directly supports, and the larger the buckle in the web the sooner the corrugations in the tread will appear.

I said that the pitch of this buckling was $2\frac{1}{2}$ in., and perfectly regular. Now, our corrugations here are of this pitch, and I believe this is a very general measurement throughout the country; surely then it is something more than a coincidence that the pitch of the buckle should be exactly of the same dimension as the pitch of the corrugation.

Now, as to the cause of this buckling or corrugation of the web of the rail, my idea is that it is caused by contraction owing to the particular rail leaving the rolls at too high a temperature, and the mass of the head and the foot together being much greater than the mass of the web, the latter is the weakest part of the section, and is the one which has to give way; and I further suggest that the "$2\frac{1}{2}$ in." bears some relation to the ratio of area of head + area of ft.: area of web, which may account for the regularity of the effects.

E

Of course, only a certain proportion of rails would leave the rolls at too high a temperature, and this would account for the promiscuous occurrence of corrugation, or, perhaps, it may be that rails rolled in intensely cold weather, though they leave the rolls at the usual temperature, may cool off quicker and thus cause the buckling.

Since writing the above, I have examined some more rails in the same stack and found further instances of the buckling, some of them so small that I could only just detect them by touch and not at all by eye. Moreover, on rails of *different manufacture* from the others, namely, on Dicker patent rails, I still detected the same effect.

Lionel E. Harvey.

Sunderland, *November 6th*, 1906.

[Mr. Harvey's observations appear to us to be exceptionally interesting and suggestive.—Eds. E.R.]

In answer to Mr. Boot's letter in your issue of November 2nd, I would like to point out to this gentleman the following facts :—

1. That corrugation is absolutely unknown on some roads, although flashing is common.
2. That corrugation takes place on ordinary railways, but is of rarer occurrence than with concrete roads.
3. That corrugation takes place on steam and cable tram roads.
4. The regular pitch, &c., of the corrugation when formed.

The above facts amply disprove Mr. Boot's theory on this difficult and complex question.

With reference to his remarks on Mr. Coxon's letter, I have carefully re-read this, and fail to find anything to justify Mr. Boot's three closing paragraphs, and from what I know of Mr. Coxon, he certainly stands in no need of elementary lessons on electrical engineering from the onetime senior demonstrator at the Battersea Polytechnic.

If Mr. Boot has the time to spare and the opportunity of closely studying the subject of corrugation, I feel sure he will find his time more profitably spent in looking for physical and mechanical solutions of the question than in further following his present theory.

It would be interesting to know if wood centre wheels have been used on any road, and if so, their effect on corrugation.

The alteration of track construction at places where corrugation has taken place, by the insertion of longitudinal wooden sleepers bedded in concrete, might prevent their reappearance after grinding, by altering one of the possible conditions causing their occurrence.

Further information from engineers in charge of tramway undertakings would be greatly valued, but men do not care to write, if their statements are misread as Mr. Coxon's letter has been by Mr. Boot.

Percy A. Yapp.

Portsmouth, *November 6th*, 1906.

Judging from the correspondence in your valuable columns *re* the above, it would be interesting to know if your correspondent has ever actually seen rail corrugations, because, from his letters, it would appear that what he thinks is corrugation, is only a slight pitting on the surface of the rail due to sparking, and has nothing whatever to do with the subject under discussion.

We should imagine these remarks emanate from a lighting engineer who probably has not had experience with this class of trouble, or even with tramways at all.

Rails.

The following has struck me as being, possibly, one of the causes of this evil on tramway rails in particular.

The power is, perforce, transmitted to the driving wheel through toothed gears ; in one of the motors the teeth of the pinion as they successively come into contact with those of the gear-wheel on the axle, exert a downward hammering action which would be transmitted to the rim of the driving wheel and cause a slight bouncing tendency—or what would be practically a vibration when the car had attained to any speed—as also would be the case, in perhaps a lesser degree on the other motor where the teeth of the pinion had a lifting action ; and as the body of the car swayed from side to side it would lighten the weight on the driving wheel on the opposite side, giving it a greater flexibility, and thereby facilitating matters for this action to take more effect.

It is my opinion that these undesirable corrugations will not be traced to one cause only, but will be found to be the effect of many combined, and the foregoing might, I think, be among the number, even if only slight in its action.

R. M. B.

London, W., *November 7th*, 1906.

I have read with interest Mr. Boot's theory as to the cause of rail corrugation on electric tramways.

Apparently, in his opinion, the arcing between the car wheels and the running rails is responsible for the corrugations.

I should be glad if Mr. Boot would apply his argument to the case of conduit tramways, in which the running rails form no part whatever of the return circuit, the return current flowing to the power or sub-station through a negative conductor tee provided for that purpose.

It is more than probable that the change in molecular structure of the metal, after rolling, straightening or bending, acted on by an intermittent rolling load, is responsible for the corrugations.

Interested.

London, *November 6th*, 1906.

I have nothing further to add to my letter of October 29th, and can only recommend the person who appears to be ashamed of his name and signs himself "Doubtful," to read my letter of that date, and the letter of Mr. Coxon, dated October 22nd, when I think he will come to the conclusion that not only is he "somewhat at sea" in his electrical ideas, but that he is also "at sea" in comprehending the English language.

I stated most clearly, exactly what he appears to think was not stated, viz. :—That in the regenerative system there must be a complete circuit, and, therefore, sparking will take place going down hill between the wheels and the rails.

Again, if he reads my letter with reference to railway corrugation, he will find there is no inconsistency, as it is possible for it to occur on some badly-laid lines, whereas with better laid and heavier rails it may not occur.

The only thing I can imagine "Doubtful" can have been doing when reading the two letters, is to have been mixing too much "spirit" with his "sea" water, and, feeling confused over the two, he took the name beginning with "B" instead of "C," because it was earlier in the alphabet, and began to criticise.

May I thank Mr. Dayson for his kind invitation, which I shall accept, and, at the same time, ask Mr. P. Weil to which section of the L.C.C. tramways he refers, and where it can be seen ?

H. Boot,
Consulting Engineer and General Manager.

Tunbridge Wells, *November 13th*, 1906.

[It would seem that some of our correspondents have not made themselves acquainted with previous articles and communications on this subject, and thus are apt to traverse beaten ground.—Eds. E.R.]

The Grouping of Electric Cells.

As your reviewer's misrepresentations concerning my little book cannot be intentional (they are probably due to the novelty of the book requiring a rather more careful reading than reviewers usually give to the works of unknown writers), you will, of course, allow me to correct them.

He says that my method of grouping 1,201 1-volt and 1-ohm cells for sending the greatest current through an external resistance of 600 ohms, would be to put them all in series, and that "any practical man would begin by throwing one of the cells away, and putting the remaining 1,200 in two parallels, giving practically the same current

as the author's method, and at half the cost." Those who have read my book at all carefully, will see that I should not group the cells in the manner here alleged, your reviewer having evidently confused my rule for finding the best (as regards current) of the *regular* groups, with my rule for finding the best *group*. Again, those who have studied Chap. IV will see the folly of throwing the odd cell away (assuming that the object is to get the greatest current as cheaply as possible); for by first connecting 1,198 cells in two parallels, and then joining this group in series with a group consisting of the remaining three cells all in parallel, they could get a greater current than the practical man, without any greater cost per ampere. And even those who have not read my book will see that there must be something wrong with the old rule, which gets more current from 1,200 cells than it can get from 1,201.

I agree that the above example, considered as a practical problem, is absurd. But it must be remembered that I am not merely giving rules for the guidance of practical men, but am also giving the true solution of a scientific problem that is erroneously supposed to have been solved long ago. This being the case, I am, of course, justified in pointing out that under certain circumstances (no matter how exceptional) I can get 400 times the current that the old rule gives as the maximum obtainable. I might, however, have proved the inaccuracy of this rule with the smallest possible battery, instead of an unpractically large one. Thus, with two 1-volt and 1-ohm cells and an external resistance of 1·24 ohms, the readers of my little book will be able to get a greater current than anyone who proceeds according to the rule hitherto taught, which says that the maximum current is obtained when the resistance of the group is as nearly as possible equal to that of the external circuit.

With regard to finding the smallest number of cells that will send a given current through a given external resistance, here again I get the better of your reviewer's practical man. He certainly arrives at an approximate answer without employing more than two formulæ; but by using only the first two of my three formulæ in Chap. V, I can get an equally close approximation to the number of cells required, and also an indication as to how they should be grouped, which is not given by *his* formulæ. All that *is* given by his two, can be obtained with less trouble from this *one*, $4 R r (C/E)^2$; and he is evidently a very practical man (that is to say, one who knows very little about the scientific part of his business), or he would be sharp enough to find this out for himself.

As for the practical value of my book, I need only say that your reviewer does not deny my claim to have shown, for the first time, how cells should be grouped for giving the greatest current (Chap. III), *and for working with the least waste* (Chap. IV).

W. F. Dunton.

London, S.E., *November 12th*, 1906.

[We are not worried about the defects of the old rule; and as for the improved grouping of the 1,201 cells, the infinitesimal increase in the theoretical current due to the use of the odd one is not worth a thought. The formula quoted is merely the combination of the two mentioned in our review, which any schoolboy could effect. But these points are beside the mark: the essence of our criticism, we said, was "that the grouping of cells is a mere academic exercise, of no practical importance whatsoever."—Your Reviewer.]

Nernst Lamp Renewals.

On reading a letter appearing in your last week's issue, under the above heading, and signed by Mr. Walton, of Gloucester, I was interested to find that he has had much the same experience as myself. I have now given Nernst lamps a considerable trial, both for street lighting, shop lighting and house lighting, and owing to the trouble with renewals, I have had to abandon their use.

In addition to the faults mentioned by Mr. Walton, I have had considerable trouble with the automatic coils, and which generally meant a new lamp. In the case of the ½-ampere lamps, the metal caps invariably come apart from the porcelain carrying the contacts, as the caps are merely secured with a little plaster of paris. This happens, say, when disconnecting a lamp from its lampholder, and results in damaging the filament with the glass globe. I think it is time that some better method of fixing the metal caps was employed.

In the case of street lighting, I found that the small interval, a minute or more, taken for the lamp to light up bright, meant a great loss of time to a lamp-lighter, who had, say, over a 100 lamps to attend to.

I have frequently been asked by shopkeepers to supply and insert renewals in their Nernst lamps, and should this renewal give out, say, within a week, as generally happens, the shopkeeper invariably refuses to pay for the renewal, let alone the time wasted. Again, on examining both burner and heating coil, it is almost impossible in many cases to observe any break, at least with the naked eye.

I might mention that in all cases the lamps are properly connected as regards polarity, our voltage is 240 volts, and is absolutely steady, the combination used being 230-volt burners, with 20-volt resistances. I have been substituting the new "Whytelite," "Radiolite," "Sunlight," &c., lamps as made by several makers in their place. I shall be pleased to hear the experience of other engineers.

James Brown, A.M.I.E.E.,
Engineer and Manager.

Electricity Works, Kilmacolm,
Renfrewshire.
November 6th, 1906.

When this correspondence was opened some two years ago, I said that the U type ½ ampere burner was far from being a success, and to-day in the face of competition from such lamps as tantalum, &c., it is most assuredly out of it. This year we have taken out most of the Nernst lamps we had installed, and many were replaced with ordinary glow lamps, which have proved as cheap to burn (taking upkeep with consumption) and far more reliable than the Nernst lamp. As long as we could procure the old type of burner we got along fairly well, with, according to our records, an average life of just over 400 hours. Now we cannot get more than half of this, chiefly because the heater gives out either from shorting to the filament or breakdown. It is very seldom that the filament is at fault. Had the A.E.G. Co. gone back to the horizontal burner they would have found the contractors ready to sell (and push) a reliable article, and not have made it necessary for them (the A.E.G. Co.) to call direct or give preferential terms to customers who, by no stretch of imagination, could be termed "the trade." Judging from the previous letters (December, 1904) the lamps that Mr. W. S. Walton now complains of are the ones that were then troublesome, so the faulty insulation of twelve months ago may, perhaps, date back to the time when these others were fixed. Whether it is the coils that cause the burners to go or not, is, I fancy, a debatable point that no contractor, who has had any experience, has yet spoken of in these columns. I should like to see some practical letters from contractors in various towns—not makers or agents who have axes to grind—so that we may for ourselves, sift the chaff from the grain, and get reliable data to go upon as to the efficiency of these lamps in comparison with other kinds now on the market.

Richard A. Parsons.

Gloucester, *November 10th*, 1906.

Referring to the letters recently published about complaints of short-lived burners, we fully agree with the reply given in your last issue.

To get at the root of the trouble, it should be borne in mind that Nernst lamps are, in their mechanical construction, so far similar to arc lamps that they need overhauling from time to time.

The renewal of automatic cut-out coils and steadying resistances is, under normal conditions, advisable after about three years' use.

When burners fail prematurely, their mere renewal is useless, and will only cause annoyance, unless *before* fixing all parts of the lamps are found to be in proper working order. It is imperative that the spring of the automatic cut-out coil

should act properly, cutting out the heater when the filament becomes incandescent, which should be within 30 to 45 seconds. It is an easy matter to adjust the spring with a pen-knife, or release it if caught.

Nernst lamps, if correctly installed and maintained, give less trouble than arc lamps.

We should like to point out that Nernst lamps cannot at present be recommended for circuits below 200 volts.

Nernst lamps are made for direct and alternating-current, and all parts are marked " = " and " ~ " respectively, and should be used accordingly. We invariably find that when small type lamps—¼ ampere " B " and ½ ampere " D "—are taken out for cleaning purposes they are refixed without regard to polarity.

The lamps are purposely made with three pins, and the third slot should be punched into existing B.C. holders, after ascertaining polarity, special punches having been designed for this.

The ½ ampere " D " type lamp, with new vertical burner, is the very lamp to compete successfully with incandescent gas light, beating in many cases public gas lighting.

We gladly offer our assistance whenever trouble arises. We have just published short and explicit instructions relating to the maintenance of Nernst lamps, and shall be pleased to forward the same to any user of these lamps on application. If our instructions are adhered to, there will be no trouble with Nernst renewals.

The Electrical Co., Ltd.
NERNST LAMP DEPARTMENT.

London, W.C., *November 12th*, 1906.

Mr. Walton is only one of many who have suffered from the vagaries of the Nernst lamp. In Stirling, however, I have obtained fairly good results from all but one size of this lamp. I have for some years now used ½-ampere A type lamps for street lighting, and have advised Luna and ¼-ampere lamps to many customers with moderately satisfactory results. But the 1-ampere lamp is here, and, I believe, elsewhere, an unmitigated failure. I was unfortunate, or foolish enough some two years ago to recommend a customer to install multiple Nernst lamps of this size, and the average life of the burners has been under 50 hours. I know of other cases here where the life has been little, if any, better. I think the manufacturers would be well advised to stop the sale of this type of Nernst lamp.

A. C. Hanson,
Burgh Electrical Engineer.

Stirling, *November 7th*, 1906.

Patents and Prejudice.

I must leave Mr. " Manufacturer " to Mr. " Statistics." But when I see my neighbours buying a lot of new stuff, I naturally conclude that they pay for it, and that things are " looking up." The " dirty foreigner " lets us have things very cheap as a rule, but it would irritate John Bull, Esq., very much if it were circulated that he did not pay for them—in Koin or Kind. This country has a very " fat purse," as well as a huge capacity for work. I think we get an income annually of about 1,500 millions—half from home investments, and the other from investments abroad.

James C. Richardson.

London, *November 12th*, 1906.

Commutator Insulation Defects.

In the annual report by Mr. Michael Longridge to the British Engine, Boiler and Electrical Insurance Co., Ltd., as published on page 742 of the last issue, I notice that he says—" micanite is unsatisfactory for use between commutator segments," and further on he says—" pure mica should be used." He goes on to state that for the year 1905 no less than 63 per cent. of motor commutator defects can be attributed to the use of compressed mica.

While I do not dispute the fact that block mica is better than built-up mica for the purpose, still I doubt very much whether the 63 per cent. of defects would be very appreciably reduced by its substitution for micanite. What about the effect of oil (lubricating) on commutator insulation of whatever nature ?

It has been the writer's experience that fully 90 per cent. of commutator breakdowns can be attributed to oil first getting into the insulation of the commutator, and there carbonising under the heat of the current and brush friction, until some of the segments become short circuited. Personally, I have saved very many armatures, that were just on the verge of burning, out by tracing the cause of the hot coil or coils to the oily insulation in the commutator, and taking pains to remove the cause by cleaning with benzine and scraping out the carbonised mica with a penknife and filling in the cavity with silicate of soda and powdered mica.

In my opinion micanite properly made and applied is a good material for commutators, but not essential, as there are cheaper insulating materials that also answer the purpose. This is an interesting subject, and I hope that others will continue this discussion.

H. W. Turner.

London, W.C., *November 12th*, 1906.

Electricity v. Gas.

The Worsted City is at last waking up to the fact that electric light is superior to gas. Opposite the Midland Station here a handsome standard supporting four arc lamps has been erected, replacing an antiquated lamp-post which stood there for many years. Bradford, with its smoke-laden atmosphere and blackened buildings, looks dull enough on bright days, but at night with its rows of paltry incandescent street lamps, it is indeed a gloomy place, and it is to be hoped that the electric lighting will be extended, as the new flame arc lamps recently erected have done much to brighten the town.

It is pleasing to notice the great increase in the use of electric light everywhere, notwithstanding the efforts of the gas companies to bring into favour again that fast dying-out illuminant—gas.

The gas lighting papers are very bitter against electric light, but one can almost pity them and their spiteful remarks—they know well enough that gas has about as much chance of coming to the front again as the horse tram, and instead of admitting this, they keep manufacturing tales which they think will prejudice people against electric light, but this is not so, as intelligent persons see through them.

Who could imagine a modern theatre or hotel lighted by gas ? The very thought of it is ludicrous. I say that before very long, gas lamps will have entirely disappeared from decent streets, and how much healthier it is to have electric light in one's house—everyone knows what a quantity of pure air is consumed by a single gas light, to say nothing of blackened ceilings, explosions, and suffocation cases ; however, gas has had its day, and few people will be sorry to see the last of it.

Old Reader.

STEATITE.—A correspondent would be glad to receive the name of firms manufacturing steatite insulators.

ELECTRICAL COMPANIES AND THE DOCTRINE OF ULTRA VIRES.

[FROM OUR LEGAL CONTRIBUTOR.]

THE supply of electricity for lighting purposes has fallen so much into the hands of local authorities, that most of the cases which come before the Courts in connection with the subject have reference to the rights and duties of municipal and other such bodies. Nevertheless, it is sometimes necessary to consider the rights and powers of electric lighting companies in relation to the supply of electricity.

It is proposed in the present article to consider some of these questions, and to dwell more particularly upon what is known as the doctrine of *ultra vires* in relation thereto.

It is provided by Sec. 4 of the Electric Lighting Act, 1882, that the Board of Trade may from time to time by provisional order authorise any local authority, *company*, or person to supply electricity. The expression "company" is defined by Sec. 32 of the same Act to mean "any body of persons corporate or unincorporate."

That a company may in certain circumstances obtain power to supply electricity is therefore clear enough; the question is—What are the powers of a company not specially floated or promoted for the purpose?

As a general rule, an electric lighting company which has been floated with the object of supplying electricity, has special powers conferred by the memorandum and articles of association. Power is thus conferred upon the company "To carry on at———and elsewhere in the county of——— the business of an electric light company in all its branches, and in particular to construct, lay down, establish, fix and carry out all necessary cables, wires, lines, accumulators, lamps and works, and to generate, accumulate, and supply electricity, and to light cities, towns, streets, docks, markets, theatres, buildings, and places both public and private," and "To carry on the business of electricians, mechanical engineers, suppliers of electricity for the purposes of light, heat, motive power, or otherwise, and manufacturers of and dealers in all apparatus and things required for or capable of being used in connection with the generation, distribution, supply, accumulation and employment of electricity."

Assuming that no power is conferred upon a company by the articles to supply electricity, a shareholder has a right in an action on behalf of himself and all other shareholders, to restrain the company from supplying electricity, although every shareholder but himself be acquiescent; but he has no right to come for a winding-up order under Sec. 79 of the Companies Act, 1862, which provides that a company may be wound up whenever the Court is of opinion that it is just and equitable that the company should be wound up (Irrigation Co. of France, 6 Ch. 176, 184). It will be seen, therefore, that if no power to supply electricity is conferred by the memorandum and articles, some steps must be taken by the company to obtain the necessary powers.

By Sec. (1) 1 of the Companies (Memorandum of Association) Act, 1890, it is provided that subject to the provisions of that Act, a company registered under the Companies Acts may by special resolution alter the provisions of its memorandum of association with respect to the objects of the company. One of the purposes for which such an application may be made is "to carry on some business or businesses which under existing circumstances may be conveniently or advantageously combined with the business of the company."

In no case, however, can any such alteration take effect until confirmed on petition by the Court which has jurisdiction to make an order for the winding up of the company. Debenture-holders are entitled to notice of the application, and creditors may, by leave, appear and object to it.

Numerous companies have availed themselves of this Section with a view to acquiring power to supply electric light; and it is probably owing to the facility with which the new powers may be obtained that the question of *ultra vires* is seldom considered. Under the foregoing powers, applications have been successfully made to the Court to confirm special resolutions to enable a gas and water company to supply electricity. Numerous examples may be cited—*e.g.*, Colombo Gas and Water Co., Ltd., *Journal of Gas Lighting*, July 20th, 1896; Rugely Gas Co., W.N. (1899), 127. A telephone company was allowed to alter its memorandum so as to supply electricity for other than telephonic purposes on condition of making a suitable change of name (in *re* Oriental Telephone Co., W.N. (1891), 153); and a tramway company obtained similar powers (Leamington and Warwick Tramways, &c., Co., ELECTRICAL REVIEW, July 18th, 1902, page 100.

Coming now to the position of a statutory company—that is to say, a company empowered to supply something other than electricity—it appears that such a body may obtain Parliamentary power to supply electricity. Gas companies existing under statutory authority may obtain power from Parliament to make application for a provisional order under the Electric Lighting Acts to produce and supply electricity for public and private purposes. There are numerous instances of such power having been conferred upon companies and upon local authorities, and there is a clause to this effect in the Model Gas Bill. For an instance of a case in which a gas company applied for and obtained the necessary powers, reference may be made to the Walker and Wallsend Union Gas Act, 1899.

BUSINESS NOTES.

Westinghouse Co-operation in Italy.—As foreshadowed in a previous issue, the negotiations between the Italian Meridional Railway Co. and the locomotive and wagon works of Ernesto Breda, of Milan, have been brought to a conclusion in so far as concerns the scheme for increasing the share capital of the latter company from £320,000 to £500,000. A proposal will be submitted at the general meeting of the Breda Co. to authorise the directors to make a further issue, when they consider it desirable to do so, so as to bring the total capital up to £800,000. One-half of the present emission of £240,000 will be taken over jointly by the Meridional Railway Co. and the Westinghouse Co. The object of the capital augmentation and participation of the Westinghouse Co. is the erection of workshops at Milan for the production of electric railway rolling stock, for which a large demand is expected to take place in the near future.

Consular Notes.—ARGENTINA.—The Belgium Consul at Buenos Ayres in a recent report, states that the importation of motors increases in proportion to the increase of the national industry. In 1902, 1,038 motors were imported, whereas in 1904 the number had increased to 2,026. Under the heading of motors, are included:—Steam motors, rich-and-poor-gas motors, benzine motors, petroleum motors, and electric motors. Germany and Great Britain have carefully looked after their *clientèles* for gas and electric motors, particularly with reference to the small industrial concerns. Certain German houses have established branches with all that care which a market of such great importance deserves. The sale by catalogue is becoming more and more difficult, the buyers preferring to select the motors which they have seen. For some short time poor-gas motors have been introduced with success. The small industrial concerns of Buenos Ayres prefer electric motors to gas motors, although their prices are a little higher. The German Transatlantic Electric Co. holds a monopoly for the supply of electric current, and consequently sells the greatest number of electric motors.

As regards boilers the import statistics show an importation of 94 in 1904, as against 70 in 1903. More than half of these are furnished by English works. The Argentine Government are occasionally in the habit of purchasing marine boilers by tender, and Belgian manufacturers have succeeded in securing contracts. The textile, candle, match, paper and refrigerating industries have up to the present been the principal buyers. For some little time the dairy industry has used various kinds of boilers, according to the importance of the installations, but, generally speaking, vertical boilers of 12 H.P. are used both in this, and the small industrial concerns. In the large refrigerating and dairy concerns, the Winterthur boiler is preferred. But as a rule, Switzerland is not in a position to secure trade in these large and cumbersome goods. The question of freight is also the reason for the importation of collapsible multitubular boilers, but they cannot be used at places where the water is charged with mineral salts. The following are the chief importers of machines, boilers, &c.:—Juan y Jose Drysdale & Co., 450 calle Peru; Cia de Fabricantes Extranjeros, calle Balcarce, 302; Tomas Drysdale & Co., calle Moreno, 436; Pruden y Ham, calle Peru, 333; Pfeiffer Hermanos, calle Peru, 425; Hasenclever & Co., calle Belgrano, 146; Agar Cross & Co., calle Defensa, 124; H. Mantels & Co., calle Peru, 401; Otto Franke and Co., calle Corrientes, 635.

NORWAY.—The Belgian Consul at Christiania reporting on the electro-thermic and electro-metallurgical industries, states that the works of Borregaard, near Sarpsborg, have delivered, in 1905, a total equivalent of 1,400 tons of ferro-silicium at 25 per cent. of silicium of a value of 200 crowns per ton. Zinc is refined by the De Laval process at Hafslund, also near to Sarpsborg; the same establishment is continuing its researches with a view to extracting zinc directly from the blende. In 1905 these works exported at least 1,500 tons of metallic zinc valued at 750,000 crowns. The electro-thermic works are also those which manufacture carbide of calcium (Hafslund, Borregaard, Notodden and Meraker). The exports reach 9,000 tons valued at from 1,400,000 crowns to 1,500,000 crowns. These figures are expected to be increased in 1906. In the same category of works are included those for the production of nitrate of lime for manures by the Birkeland-Eyde process. This industry has an immense future, an abundant supply of water power being available.

Electric Wagon Lifts.—We recently mentioned that MESSRS. A. SMITH & STEVENS had received the order for two controllers for a pair of 30-ton wagon lifts to be erected by Messrs. Craven Bros. in the new N.E.R. goods warehouses at Newcastle. The lifts are for transferring wagons between the lower and upper floors. For operating the controller, three push-buttons are provided marked "Up" "Down" and "Stop." Momentary pressure of

either of the two first-named buttons starts the lift, which continues to travel until the "Stop" button is pressed, or the floor is reached, when it stops automatically. The lift may be operated from either floor or from the cage itself. Owing to the heavy current to be dealt with, double relays are employed, and the rheostat is divided into two portions. On energising the solenoids the first portion of the rheostat automatically cuts out resistance till a safe starting current is reached, and the machine will start if not overloaded. But in case of overload and non-starting no more resistance will be cut-out, and the motor is thus protected independently of the fuse. The moment the lift moves it gives motion by mechanical means to the second portion of the rheostat, cutting out the starting resistance and gradually giving full speed to the motor. The switches are so arranged that on stopping, both portions of the rheostat must return to the original position with all resistance re-inserted before it is possible to re-energise the magnets for the next journey. The complete system of magnets and switches is cross-connected electrically and mechanically, so as to produce the following safeguarding results. When one direction magnet is operated the other is rendered powerless. If it is attempted to operate both simultaneously neither can be moved. The reversing switch cannot be moved while current is on to the motors. The circuit-breaking switch cannot be moved while the reverser is moving or if the reverser is in the wrong position. The brakes cannot be released till sufficient current has been given to the motors to deal with the heaviest load. The controller stops the lift automatically at both ends of the travel, and emergency switches are fitted to cut off current from all circuits, if by mischance the cage should over-travel a very small amount at either end. In spite of the numerous functions performed, the simplicity of design is such that only four magnets and a small pair of relays are required for all the motions. All switches and contacts are of unusually heavy pattern, and are fitted with magnetic blow-outs. Each controller is of 100 H.P., supplying current to two motors of 50 H.P. each. They have been constructed under Stevens & Major's patents, and will rank with the largest automatic machines yet produced.

An Electricity Supply Company's New Showroom.—A testimony of the value of showrooms as a valuable auxiliary in pushing the work of a supply company's undertaking comes from the RICHMOND (SURREY) ELECTRIC LIGHT AND POWER CO., LTD. This company has recently purchased a building in a prominent part of Richmond, and expended a good outlay in tastefully refronting with art faïence, and appointing new offices and showrooms. The recent reduction made by the company of their rate for current for heating and cooking purposes has given a good impetus to the demand for radiators, and the fact that all the best types can be seen on view certainly counts as a factor in an inquirer's decision. Even the short experience up to the present gives every evidence as to its value, and more than justifies its institution. There is no doubt that the public greatly value being able to examine actual apparatus at will. Various types of lamps are exhibited, from tantalum and such-like, up to arc lamps, so that shopkeepers and others can see what form of lighting is best suited to their own individual needs. There are also facilities for showing any small motors that may be adapted to local needs.

Book Notices.—*Etat Actuel des Industries Electriques.* Paris: Gauthier-Villars. 1906. Price 5 fr.—This volume consists of eight papers, containing a survey of modern electrical practice in general. M. Paul Janet, Professor at the University of Paris, and Director of the Central Laboratory at the High School of Electricity, covers swiftly the whole ground in the first paper. After being somewhat historical, he turns his attention to generators, direct and alternating. He indicates how their forms had become practically fixed until the advent of the steam turbine, which altered everything. The author evidently holds a brief for the steam turbine. Perhaps the most suggestive part of his paper is that showing how turbine running affects the dimensions of an alternator in directions parallel and perpendicular to its axis. M. Chaumat, of the Higher School of Electricity, is the author of the second paper, which deals in an exhaustive manner with "The Recent Progress of Electro-Chemistry." The great point of interest is the detailed description of modern electric furnaces. The author proceeds to show that electric furnaces hold the following advantages:—(1) The temperature is much higher than can be obtained in ordinary industrial furnaces; (2) the source of heat being internal, there is a much better yield; (3) the very high temperature causes, in metallurgical operations, the formation of fluid slags, which are easy to separate from the metal; (4) the atmosphere is non-oxidising. Among the furnaces described are those of Keller, Héroult and Gysinge. The last, which belongs to the induction type, is remarkable inasmuch as it possesses no electrodes. It has been on trial at Gysinge, in Sweden, since February, 1900, and consists of a transformer whose primary is fed with current at 3,000 volts, and whose secondary consists of a single convolution, made of crucible metal and having the form of a circular channel hollowed into a block of refractory metal. This secondary, being always closed upon itself, is traversed by an intense current, which very soon melts the metal. The regulation of heat intensity is most easily accomplished by means of the primary current. The first furnace of this type gave 80 kilogrammes of metal per operation. In the domain of chemistry, the author treats of the various ferro-compounds, of the manufacture and industrial employment of ozone and of the manufacture of perfumes. The third paper is on "The General Principles in the Construction of Continuous-Current Dynamos," and is by Engineer M. Picou. Though there is nothing new, the paper is a valuable epitome of the fundamental notions leading up to the present perfection of continuous-current generators. "Industrial Electric Motors," by M. Hillairet, comes next. Direct-current motors are first dealt with; there is a dissertation upon each class, and a paragraph or two on rheostatic control, after which A.C. motors are discussed. There is an interesting page on the relative weights of various types of motors. M. Junau, in the next paper, enters into an exhaustive inquiry regarding the present condition of the accumulator industry. With great wealth of detail he thrashes out the theory and practice of the lead accumulator, and the paper is abundantly illustrated. "The General Principles in the Construction of Alternators," by M. Boucherot, consists of 80 pages on principles of design, with a liberal number of drawings and photographs interspersed; but perhaps the paper that will be read with the greatest interest by many is that of M. Pierre Weiss, on "The Recent Progress of the Electric Light." The theory and practice of the osmium, the tantalum and the Nernst lamps are gone into, and a page or two is devoted to the mercury-vapour lamp. The last paper of the series is by M. G. de la Touaine, on the present condition of the telephone. Its gradual evolution is detailed, and thorough descriptions of various exchanges, aerial and subterranean lines, &c., are given. There is an interesting paragraph on the relative line-lengths of several European countries, as well as many statistical particulars affecting the service. Altogether the book reaches 246 pages, and containing, as it does, the latest word on many electrical industries, is sure to have a wide circulation.

"Technology Quarterly." Vol. XIX, No. 3, September, 1906. Boston, Mass.: Massachusetts Institute of Technology.

"Medizinsche Anwendungen der Elektrizitäts." By M. U. Dr. S. Jellinek. Munich: R. Oldenbourg. M. 10.

"Bases d'une Théorie Mécanique de l'Electricité." By Seligmann-Lui. Paris: H. Dunod & E. Pinat. Fr. 3.

"La Télégraphie sans fil et la Télémecanique à la Portée de tout le monde." By E. Monier. Paris: H. Dunod & E. Pinat. Fr. 2.

"Annual Report of the 110th Session of the Glasgow and West of Scotland Technical College." 1906. Glasgow: The College.

"Proceedings of the American Institute of Electrical Engineers." Vol. XXV, No. 10, October, 1906. New York: The Institute. 50 c.

"Bulletin of the Imperial Institute." Vol. IV, No. 3, 1906. London: The Institute, or Messrs. Eyre & Spottiswoode. 1s.

"The Physical Review." Vol. XXIII, No. 5, November, 1906. Lancaster, Pa., New York and London: The Macmillan Co.

"Traité de Manipulations et de Mésures Electriques et Magnétiques Industrielles." By H. Pécheux. Paris: J.-B. Baillière et Fils. Fr. 6.

"The Motor Manual," 9th edition, 1907. Compiled by the staff of the *Motor*. London: Temple Press, Ltd. 1s. 6d. net.

"Was Sind und Wie Entstehen Erfindungen? Eine Entwicklungstheoretische Studie." By Josef Löwy. Vienna and Leipzig: A. Hartleben. M. 1.

Johnson & Phillips's New Paper-Cable Shop.—The London County Council at last week's meeting granted a special permit to MESSRS. JOHNSON & PHILLIPS, LTD., to erect a cable shop having a cubical capacity of double that which is allowed under the London Building Act. We understand that this new shop will be used for the manufacture of Manila paper insulated cables.

Amendment of Patent.—Mr. F. H. LEWIS, of Brighton, is applying for leave to amend Specification No. 27,199 of 1903 for improvements in electric arc lamps. See our advertisement pages for particulars.

Dissolutions and Liquidations.—WEBSTER ELECTRICAL ENGINEERING CO., LTD.—A meeting is to be held at District Bank Chambers, Bradford, on December 11th, to hear an account of the winding up from Mr. W. M. Gray, liquidator.

BRYAN DONKIN & CLENCH, LTD.—A meeting will be held at Derby Road, Chesterfield, on December 17th, for receiving an account of the winding up from Mr. A. G. Webb, the liquidator.

PORTABLE ACCUMULATORS, LTD.—This company is winding up voluntarily with Mr. C. L. Waltner, 28, Sheen Park, Richmond, Surrey, as liquidator.

LONDON OUTER CIRCLE RAILWAY SYNDICATE, LTD.—A meeting is to be held at Salisbury House, E.C., on December 10th, to hear an account of the winding up from the liquidator (Mr. W. R. Morrison).

DEWSBURY ELECTRIC MANUFACTURING CO., LTD.—This company is winding up voluntarily, with Mr. R. S. Dawson, 9, Charles Street, Bradford, as liquidator.

ELECTRICAL TESTING LABORATORIES, LTD.—This company is winding up voluntarily, with Mr. W. P. Tomes, 17, Devonshire Chambers, E.C., as liquidator.

LIQUID (ELECTRIC) REGISTER SYNDICATE, LTD.—Creditors must send particulars of their debts, &c., to Mr. D. S. Fripp, 14, Finsbury Circus, E.C., the liquidator, by December 10th.

Catalogues and Lists.—MESSRS. FALK, STADELMANN AND CO., LTD., Farringdon Road, E.C.—Illustrated list No. 317 (24 pages), in which are shown and priced a number of very attractive designs in art-metal work of the "Aureola" luminous electrical radiators. They are made with wrought-iron, polished brass and copper framework respectively, and with polished copper and copper fluted reflectors. Another list (No. 239A) gives full particulars, sizes, prices and current consumption of "Aureola" flame arc lamps for direct and alternating current.

MESSRS. GEORGE HATCH, LTD., Queenhithe, Upper Thames Street, E.C.—Four-page list describing the "Clyde" clutch double-worm pulley block, the "Champion" double-worm pulley block,

also a portable crane and the "Universal" all-steel rack lifting jacks. Lifting capacities and prices are set out in tabular form.

Messrs. Ercole Marelli & Co., Milan.—Several illustrated price-lists giving particulars, in the Italian language, of electric ventilating fans.

Improved Electric Supplies, Ltd., 7, Great Newport Street, W.C.—Eight-page price list giving illustrations of flame, miniature, open and enclosed, and twin miniature enclosed, arc lamps; also showing arc lamp bracket arms, hoisting gear and winches. A second sheet draws attention to the company's "Wonderlite" and "Piksherlite" for shop window and picture lighting respectively.

The Standard Metal Engraving Co., Chancery Lane, W.C.—Calendar card with monthly slips for the remainder of 1906. Two specimen name-plates in metal and ivoroid are attached to the card.

Simplex Conduits, Ltd.—Simplex socket price list for 1907-8 (bright red limp covers, gilt lettering, 50 pp., 4 in. × 8 in.). This is a section of the eighth edition of the company's annual catalogue, in which every effort has been made to show all prices and illustrations as clearly as possible. The company now issue three main lists, as follows:—Red Book, relating to light-gauge conduits and fittings for socket junctions; Blue Book, relating to screwed conduits and fittings; and the Grey Book, setting forth continuity material. Each list is quite complete in itself, and conduit and accessories can be requisitioned for erection on any of these three methods of junction with the aid of the corresponding catalogue. We are informed that the Standard Report and Specification, which was issued a month or two ago, in its requirements for standard conduits and fittings, follows very closely what has been Simplex practice for years past. We understand that with one or two minor exceptions, which are stated to be quite insignificant, the Standard Specification is the Simplex specification. Exact external diameters are to be adopted; the Simplex thread is specified as the standard conduit thread, and the Simplex socket junction as the standard method of joining with ordinary conduit.

Messrs. Geipel & Lange, St. Thomas' Street, London, S.E.—A number of trade circulars relating respectively to the Vulcan seamless steel conduit tubes and fittings, Okonite and Manson insulating and protecting tapes, Okonite electric light conductors, and the turn-down incandescent lamp.

Messrs. Mavor & Coulson, Ltd., Glasgow.—The November date-card issued by the firm gives some information concerning the lubrication of the Pick-quick coal-cutting machines.

Messrs. Donovan & Co., Birmingham.—List No. 26, showing, and giving prices of, a few neat designs of cord pendant fittings; also List No. 27, describing briefly, illustrating, and stating prices of, distribution boards for flats, tenements and workshops, and tumbler switch and fuseboards.

Messrs. Mather & Platt, Ltd., Manchester.—12-page catalogue in their well-known style, giving a good deal of tabulated data and some excellent illustrations of their D type dynamos for 110, 220, 440 and 550 volts.

A.E.G. Foreign Department, 125, Charing Cross Road, W.C.—16-page publication (No. 10) particularising and attractively illustrating their Holophane globes and Pagoda reflectors for incandescent and Nernst lamps.

Ediswan Patent Flat Wall Sockets.—The Edison and Swan Co. have been recently engaged in perfecting a form of wall plug, which should not only possess great durability and high insulation, but should also be particularly artistic in appearance and lend itself to any scheme of decoration. The new socket, which is described in Leaflet No. A 2,074, consists of a highly glazed porcelain interior, in which the metal current-carrying portions are sunk, and it is supplied either with or without an outside metal case, which in its turn may be supplied either with or without a lid specially hinged to cover it, and so completely to close the socket when not in use. The principal feature is that the socket and plug are so designed as to lie parallel with the wall or skirting board, instead of, as in all other cases, at right angles to it, thus projecting out into the room. This advantage will be apparent to all who have times innumerable had to send men to repair blown fuses caused by some accidental blow having shattered the ordinary form of socket. We understand that already large orders for this plug have been received.

Engineering Labour Troubles.—A conference took place at Newcastle on Monday between the engineering employers on the North-East Coast and their workmen, who made an application for an advance of 2s. a week on time wages and 5 per cent. on piece rates. According to the *Financial Times* the conference lasted several hours, and at the close the employers intimated that the condition of trade in the engineering shops on the North-East Coast was worse than it was a month ago, and the men agreed not to press the application for three months. It was stated officially that the men will meet the employers again on the wages question in February next.

Trade Announcements.—The Sanitas Electrical Co., Ltd., have removed to 61, New Cavendish Street, W. A circular showing small illustrations of a number of their specialities in electro-medical apparatus has been issued.

Mr. Geo. B. Crockatt having severed his connection with the Reason Manufacturing Co., of Brighton, has entered into partnership with Mr. R. S. Pike, and they will in future conduct business under the name of Crockatt & Pike, Caxton House, Westminster, S.W., as agents for electrical and mechanical plant and accessories.

The Cleminson Electric Lamp Attachment, Ltd., of Manchester, have now sold the sole licence for the manufacture of the Cleminson Lamp fitted with the Cleminson patent high insulation collar for Great Britain and Ireland, and the Isle of Man, to The Traders Supply Co., 40, South King Street, Manchester, to whom all future inquiries should be addressed.

Messrs Kelvin & James White, Ltd.—We are requested to state that Mr. S. B. Wilson has been appointed London manager of the electrical business of Messrs. Kelvin & James White, Ltd., in place of Mr. Patrick Hamilton, retired. Mr. Wilson has been for many years in the service of the company, and is thoroughly conversant with every detail of the business.

Milan Exhibition Awards.—We recently announced that Messrs. Schiff & Co. had received a gold medal at the International Exhibition at Milan; we are now informed that they have in addition received the Grand Prix for their carbons after final tests had been made of various qualities.

The Combination Metallic Packing Co., Ltd., of Gateshead-on-Tyne, has been awarded a gold medal for its exhibit at this Exhibition.

Bankruptcy Proceedings.—Albert Dickinson, electrical engineer, Wortley, Leeds.—A first and final dividend of 2s. 3⅜d. in the £ is payable November 20th. Official Receiver, 22, Park Row, Leeds.

W. Leslie and A. F. Cheesman, electrical engineer and spinster, late of Putney, now at H.M. Prisons (Brixton and Holloway respectively). First and final dividend of 4s. 6½d. in the £, payable from November 14th. H. W. Figg & Son, 128A, Queen Victoria Street, E.C.

To Manufacturers.—Mr. Victor H. Coates is open to negotiate with firms who are willing to undertake the manufacture of engines, boilers, and special machinery as made by the late firm of Victor Coates & Co., Ltd., of Belfast. An announcement to this effect appears among our advertisements to-day.

LIGHTING and POWER NOTES.

Bacup.—The T.C. is applying for powers to borrow £7,000 for E.L. purposes, and also for the appropriation of a site for a transformer station.

Bath.—An offer has been made to the Corporation for the acquisition of the electrical undertaking, by or on behalf of the company which four years ago obtained Parliamentary powers as the Somerset and District E.P. Co. The company is stated to offer exceptional terms, and to reduce the cost of the public street lighting by 1d. a unit.

Bideford.—The U.D.C. has been informed by the Bideford and District Electric Supply Syndicate of its intention to apply for a prov. order.

Brandon and Byshottles.—At a meeting of the above U.D.C., on the 5th inst., the Council awarded Messrs. F. Reid, Ferens & Co., of Newcastle-upon-Tyne, the contract for the lighting of Brandon Colliery, Brandon Village, and Browney Colliery Streets. The installation is to consist of 145 lamps of 16, 25 and 32 c.p. Overhead mains will be run on creosoted wood poles.

Bray.—(Co. Dublin.)—At the meeting of the U.D.C. last week the report of the Lighting Committee recommended that the E.L. undertaking should be disposed of. The engineer's report showed that to make the works remunerative a sum of £4,000 would have to be expended upon them. Under the present conditions the concern could not continue to exist, the switchboard having been condemned by the Inspector of Factories. As the result of a long discussion, it was decided to purchase a new switchboard.

Canada.—Toronto.—The Stark Electrical Co., of Toronto, has secured a contract from the Welland (Ont.) T.C. for street and other lighting in the town. The contract is for 2,000-c.p. arc lamps for an all-night service, at $40 per lamp per annum, with a low guaranteed rate for residence lighting.

Sault Ste. Marie.—It is officially saated that extensive improvements are contemplated in the power plant of the Lake Superior Corporation, and the plans are now in the hands of the contractors. The cost of the improvements will be near $1,000,000, and it is estimated that the work will be completed about six months hence. The president of the Lake Superior Corporation intimates that negotiations are now in progress for the sale of energy to several large industrial concerns which will erect works at Sault Ste. Marie.

Carnarvon.—The Electricity Committee has recommended the T.C. to promote a private Bill in Parliament to authorise and confirm the agreement with the National Electric Construction Co. for electric lighting, and to enable the Council to raise loans under the agreement.

Castleford.—The U.D.C. has decided to approve of an E.L. scheme submitted by the Electrical Power Distribution Co., which will apply for a prov. order.

Cheshire.—The scheme which a House of Commons Committee rejected some few years ago, for supplying electricity to local authorities in certain districts of Cheshire, is being revived in a somewhat modified form. The provision with regard to power gas will not be included in the intended Parliamentary Bill. The area which it is proposed to supply with electricity was originally included in the North-Western Electricity and Power-gas Bill, which received the Royal Assent in 1903. It is proposed to supply energy from at least six power stations, suitably situated, so that the outlying rural districts and more remote towns and villages will have the advantages of electricity, for lighting and power, on practically the same terms as the large towns.

Continental Notes.—GERMANY.—A proposal to utilise the rainfall in the mountainous districts of Prussia for the generation of electric current on a large scale has been put forward by Prof. Vogel, of the Berlin Technical High School. From the charts already published by the Meteorological Institute of Berlin, it is shown not only that the rainfall is considerable, but that it invariably strikes the crests of the mountains. Hence the professor suggests its capture in the higher altitudes by means of masonry reservoirs constructed on the edges of the mountain ranges. With the utilisation of only half the water power thus available in an ordinary year, it is estimated that electric current equal to 650 million KW.-hours could be generated, giving a yearly revenue of 125 millions of francs.

The enlargement of the Duisburg electrical works at a cost of 2,500,000 marks has been decided upon.

A farm near Tandslet on the island of Alsen is to be provided with electric light and power generated by a windmill on the system of the Danish professor, La Cour. The power generated will be used to work thrashing, straw-cutting, washing and other machines, besides supplying light to the dwelling and working buildings.

SPAIN.—Tenders to take over the E.L. concession for a period of eight years are being asked for by the Carideleda (Avila) municipality.

ROUMANIA.—The municipality of Pitesei has just invited tenders for the establishment of an electricity works in the town.

FRANCE.—La Compagnie La Central Electrique du Nord is erecting a large generating station at Wasquehal, from which to supply energy required by Compagnie l'Electrique Lille, Roubaix, Tourcoing, and La Compagnie Nouvelle des Tramways de Roubaix, Tourcoing. The plant will have a capacity of 11,000 KW., of which about 4,000 KW. will be available, it is expected, before the close of the year.

ITALY.—The hydro-electric station of the Anza Electric Power Co., at Piedimulera, where 8,000 H.P. will be available, will be ready for working early in 1907. The company is also installing a steam central station at Novara.

The total income of the Moncenisio Power Co., of Turin, for the past year was 201,695 lire for the sale of energy, and 17,233 lire from rents and other sources, making a total of 218,928 lire; against this, working costs amounted to 78,892 lire, leaving a substantial sum to pay interest and establish a reserve fund. The Lower Fall producing 2,600 H.P., has been working satisfactorily, and the Upper Fall, which will generate 2,300 H.P., will be ready, it is hoped, for working in January, 1907.

The English Croun Spelter Co., Ltd., working the Calamina Mines, Bergamo, have, through their director, Mr. Arthur A. Francis, obtained a concession to take sufficient water from the torrent Vallepiana to give them respectively 1,681 H.P. and 1,408 H.P. at two different falls.

Coventry.—Considerable inconvenience has been caused to power users in Coventry in consequence of a breakdown of one of the boilers at the Corporation electricity works. It has necessitated, says, the *Midland Daily Telegraph*, for the time being a large diminution in the consumption of electrical energy for power purposes, and a revision of working hours in the factories affected, among which are many prominent cycle and automobile manufactories. A representative of the above paper has been informed that an inspector from the National Boiler Insurance Co. visited the works on Sunday last in response to an urgent call, and after inspecting one of the six boilers in use, expressed the opinion that it would be unsafe to run it. Mr. J. A. Jeckell immediately arranged with the largest power users in the city to curtail their their consumption of enerey to the fullest possible extent in the meantime. In order to assist in this direction, it was suggested that the factories should be run, where possible, at night instead of during the day, and we understand that to this request the power users have responded loyally. The Electric Light Committee had taken steps to meet the increased demand for energy, but unfortunately, some delay has arisen in the delivery of the new boilers that were ordered some time ago. The first one, however, arrived on Monday, and our contemporary is informed that there is every reason to hope that the first of the new boilers will be at work within a period of three weeks. The Daimler Motor Co., on hearing of the matter, arranged to work through the night. Lighting consumers are also asked to help in curtailing consumption.

Dalkeith.—In regard to the Bill to come up next session in connection with the Electric Supply Corporation, Messrs. Crompton & Co., Ltd., have asked the T.C. to approve of their transferring the E.L. order to the Corporation.

Derby.—The borough electrical engineer (Mr. T. P. Wilmshurst) has presented a lengthy report to the E.L. Committee, in which he sets forth extensions which he estimates as necessary to put in hand forthwith, and the cost of the new works is put at £47,000. This includes £15,690 for buildings and foundations, £2,200 for a coal bunker bay, £8,400 for four boilers (complete with brickwork, superheaters, chain-grate stokers, &c.), £1,100 for an economiser, £1,230 for chimney, fans, motors, &c., £10,900 for two turbo-dynamos with condensing plants, £1,000 for switchboard and connecting cables, £2,330 for piping, £1,000 for feed pumps, &c., and £1,500 for sundries and contingencies.

At the statutory meeting of the Council on Friday, Alderman Butterworth proposed that £47,000 be granted for the extension of the supply, and that the tender of Messrs. C. A. Parsons & Co., amounting to £10,686, be accepted for the supply of two 1,000-H.P. turbines. He pointed out that in 1900 the output was 617,000 units, at a cost of 1¾d. per unit, and last year the output was 2,617,000 units and the cost ·88d. After a long discussion, the report was adopted.

Durham County.—At a meeting of the C.C., on the 7th inst.. Mr. Leonard moved that an electrical expect be employed by the Council to investigate and report on the practicability of a county electric supply scheme. The Chairman (Mr. John Wilson, M.P.) said that since the special meeting of the Council was held in connection with this matter, two questions had been submitted to the L.G.B., which had replied in effect that express statutory authority would be necessary before the Council could incur any expense with regard to experts.—Eventually the E.S. Committee was re-appointed to resume its inquiries and report.

Falkirk.—An electric power installation is being put down at the Callendar Colliery, near Falkirk.

Formby.—The U.D.C., on November 8th, decided to apply to the B. of T. for a prov. order for E.L., which is to be worked by the Formby and Freshfield E.L. Co. The charges for energy will be 4d. per unit for private lighting, 3d. for public lighting, and 2d. for power and heating. The company will pay the cost of obtaining the order.

Guisborough.—The South Durham and Cleveland Electric Power Co. has informed the U.D.C. that it intends laying E.L. mains in the town forthwith.

Hereford.—A L.G.B. inquiry was held on November 7th into the application of the T.C. for a loan of £6,250 for extensions to the plant at the E.L. works. There was no opposition.

Hove.—The T.C. has decided to supply energy for heating and power to consumers at Aldrington at 5d. per unit for the first hour, and 2d. afterwards.

Huddersfield.—A new engine, dynamo, &c., is being installed at the electric power station at Longroyd Bridge at an estimated cost of £7,630.

To extend the use of electricity for lighting purposes, the Committee has prepared a scheme enabling intending consumers to have the wirings and fittings fixed upon payment of an annual rental.

Ivybridge.—The U.D.C. has sealed an agreement with Messrs. Heath & Co. for public lighting by electricity. The lighting will be commenced at the New Year.

London.—L.C.C.—At last week's meeting the Finance Committee, in the course of a report referring to the Islington E.L. undertaking, reminded the Council of the instructions given to impress upon the B.C. the advisability of establishing a reserve fund. It appeared that the B.C., in reply, stated that the accounts for the year ended March 31st, 1906, showed a surplus of £14,139, and that the borough had resolved to carry the surplus to a reserve fund. As it appeared to the Finance Committee that the amount in question was not represented by cash or investments, but only by book debts and stores, and could not be drawn upon if needed, it again communicated with the B.C., pointing out that the fund was not an effective reserve fund, and inviting any further observations which the borough might wish to offer. The Finance Committee of the B.C. now stated that it did not deem it necessary to make any further observations, and that the refusal of the C.C. in the past to sanction a loan for working capital had rendered it necessary to use the reserve fund temporarily for that purpose. With regard to this statement, the C.C. Committee observed that the late vestry in November, 1897, applied for a loan of £14,000 for works which it was unable to specify as the loan was desired to enable mains, &c., to be laid to consumers' premises as requests for supply were received, and in that application a reference was made to the necessity for working capital. A reply was sent by the C.C. that a loan could not be sanctioned for works in respect of which no plans or particulars had been furnished. The question of a loan for working capital was however not specifically considered by the C.C. The Committee concluded by stating that, having drawn the attention of the B.C. to the matter, they did not think that the C.C. could take any further action in regard to it at the present time.

After discussion on Tuesday, the Council resolved to lend £13,713 to the Stepney B.C. for electric lighting purposes.

(Continued on page 795.)

A "WIRELESS" STATION FOR LONG-DISTANCE COMMUNICATION.

[BY OUR BERLIN CORRESPONDENT.]

A HUGE wireless telegraph station, intended for communication with vessels crossing the Atlantic on the one hand, and the remaining European wireless telegraph stations on the other, has been recently inaugurated by the German Wireless Telegraph Co. (Telefunken Co.), at Nauen, near Berlin.

This station, the working of which was a short time ago demonstrated to an invited party, is the largest of its kind in Europe, and includes an iron tower, 100 m. in height, carrying the aerial. As the iron framework of this tower has a triangular cross-section of only 4 m. edge, it will be readily understood that great difficulties were met with in its construction, its considerable weight and great resulting strain having to be transmitted to safe foundations. The three vertical corner members are braced together by diagonal ties, which at the foot of the tower are combined in a cast-steel sphere resting in a suitable bearing, the enormous downward pressure being transmitted to the concrete foundations through an intermediate insulation.

The ascent of the tower is made by a flight of stairs; at a height of 96 m., a platform is arranged from which the

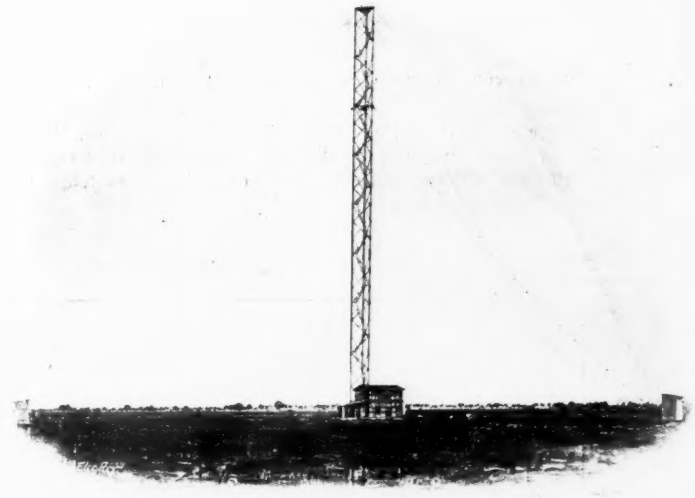


FIG. 1.—TRIANGULAR IRON WIRELESS TELEGRAPH MAST, WITH AERIAL AND STATION BUILDING.

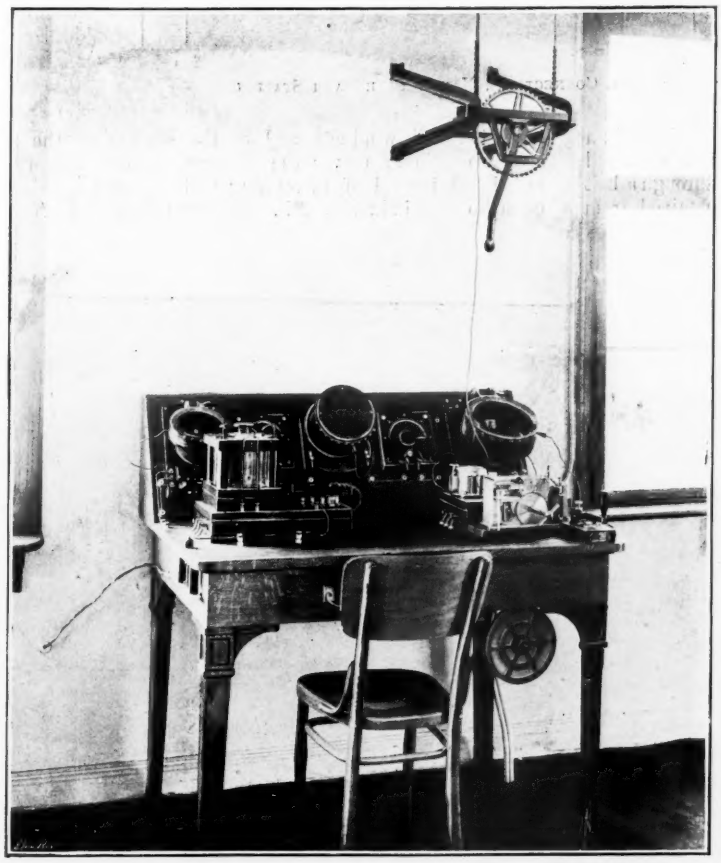


FIG. 2.—OPERATOR'S DESK, CONTAINING RECEIVING INSTRUMENTS.

three pairs of pulleys for drawing the antenna in, are controlled. At a height of 75 m. are arranged the stays which alone keep the tower in a vertical position, and which are attached at their lower ends to three anchorages situated at about 200 m. distance from the foundations of the tower. On account of the enormous electric pressures—resulting in spark lengths of up to 1,000 mm.—the three upper insulators had to be immersed in oil.

The aerial takes the shape of an umbrella, comprising six sections, the two opposite sections in each case balancing one another through the three pairs of pulleys above mentioned and thus reducing the strain on the tower, due to the wire network, to a minimum. The total surface covered by the antenna system is about 60,000 sq. m.

The earthing comprises a similar network of wires buried in the ground, and covering a surface of about 126,000 sq. m.

The station building contains the engine, telegraph and dwelling rooms, situated on the ground floor, and the high-tension room on the first floor. The whole of the building is heated by the exhaust steam from the engine.

As regards the inside arrangement of the station, a standard portable engine of about 35 H.P., working at a pressure of about 100 lb. per sq. in., and with a speed of 120

R.P.M. supplies the motive power, coal or coke being used as fuel. Water is obtained in the vicinity, and, in order to save fuel, the engine in the case of continued operation is kept at one quarter steam during prolonged intervals in transmission, the available pressure being then sufficient for the sending of short telegrams. As soon as any extensive transmission is in view, full steam can be obtained within a few minutes, when operations can be resumed to their full extent. A single-phase alternator is operated through a belt from the engine, the exciting current being obtained from a small D.C. machine direct coupled to the generator. The latter has an output of about 25 KW. at 750 R.P.M. and 50 periods. The generator coils are protected against excessive pressures by safety cut-outs: the leads being carried to a switchboard installed in the telegraph room, on which have been arranged all the safety devices, switches and measuring instruments, comprising a double-pole switch with fuses, ammeter, voltmeter, frequency meter, a transmitting relay and a blocking relay.

The alternating current is fed through four primary choking coils to four induction coils which are installed, like the rest of the high tension apparatus, in the upper storey.

The transmitting circuit comprises a condenser made up of 360 large Leyden jars giving an aggregate capacity of 400,000 cm. arranged in triple series connection. There is, further, a ring-shaped single spark gap without ventilation, and a self-induction consisting of a silvered copper tube spiral with connections, both for the exciter circuit and for coupling the antenna and connecting the earth conductor. A stationary measuring circuit leading to the ondometer enables the length of the waves in the exciter circuit to be measured and the coupling to be determined at any moment. The Leyden jars are charged from the secondary windings of the four induction coils, to which four high-tension choking coils are connected in series. Owing to the accurate resonance, this enormous capacity is charged by the aid of a relatively small amount of energy. The induction coils are switched off the battery by short-circuiting the primary induction coil windings, and at the same time the A.C. generator windings over the primary choking coils above mentioned, instead of by opening and closing the primary circuit of the induction coil. The switching-in is effected by breaking this short circuit. Owing to the considerable current intensities obtaining therein, a special relay switch had to be constructed, which is actuated by an ordinary Morse key arranged on the receiving table in the telegraph room.

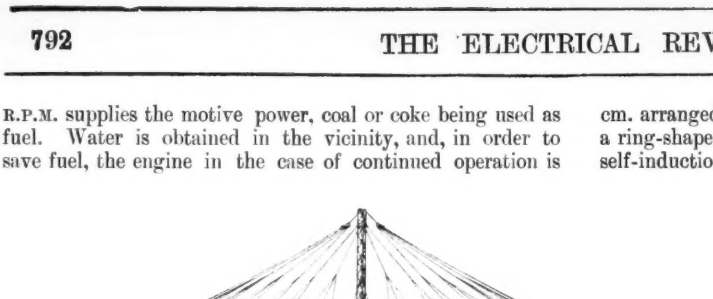


FIG. 3.—SHOWING THE ARRANGEMENT OF THE AERIAL WIRES.

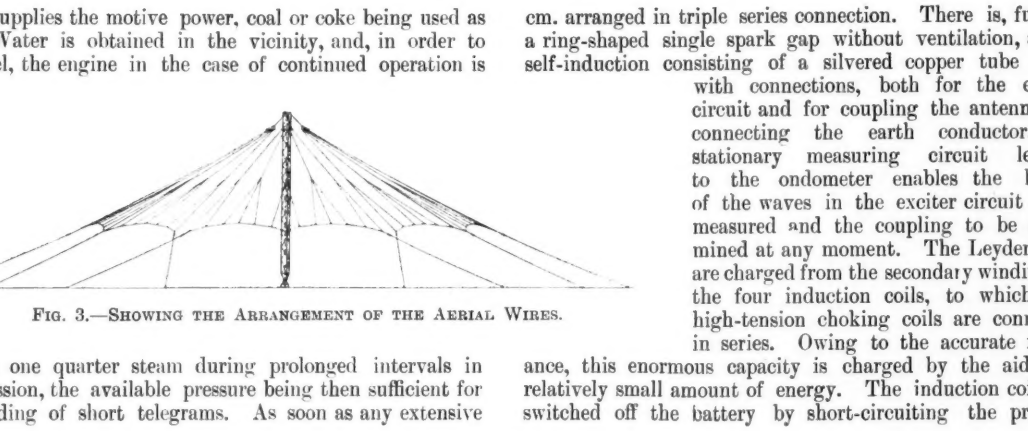


FIG. 4.—DIAGRAM OF ELECTRICAL CONNECTIONS, NAUEN TELEGRAPH STATION.

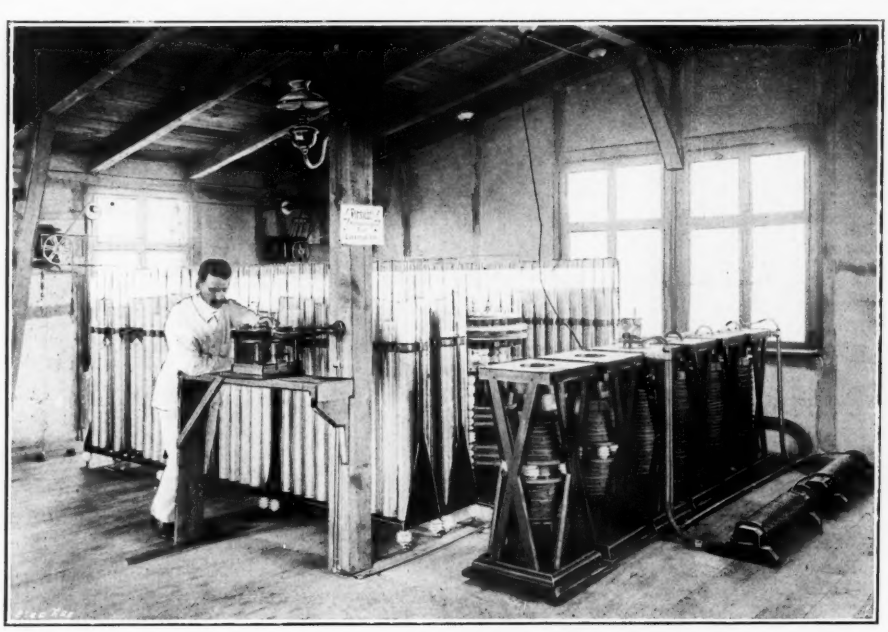


FIG. 5.—WIRELESS TRANSMITTING APPARATUS, SHOWING LEYDEN BATTERY, &C.

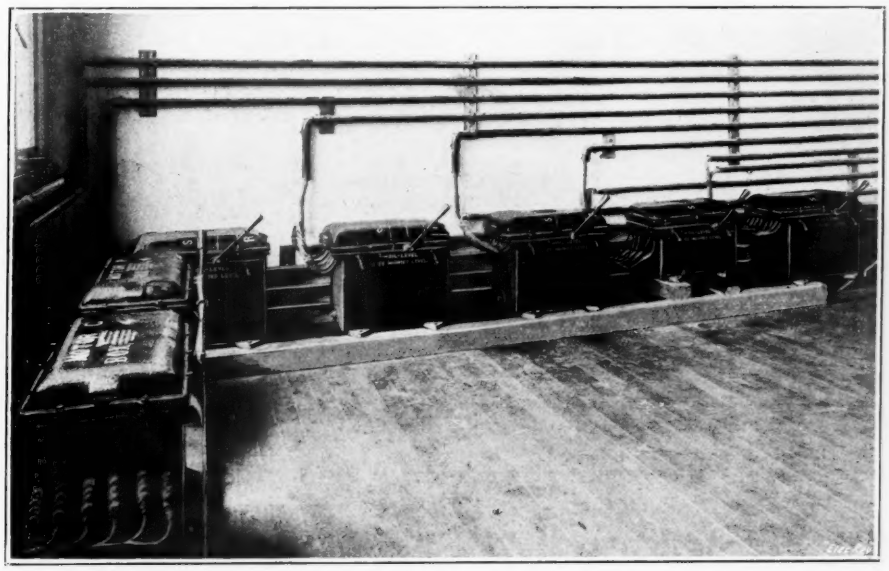
The transition from "sending" to "receiving" is effected by operating a switch, by means of which the antenna and earth are switched over from the sending to the receiving circuit, while the alternating-current circuit is at the same time switched out by the blocking relay, thus rendering transmission impossible. This arrangement has proved necessary in order to protect the sensitive cells and coherers from the influence of the exciting circuit. All the receiving apparatus, as well as the condensers and coils required in tuning the receiving circuits, are mounted on a common table, installed in the telegraph room. This table carries a desk-shaped fitting, on which part of the accessory apparatus has been installed, thus ensuring great ease of operation and supervision. Owing to the arrangement of the receiver, telegrams can be received either independently with the inker or sounder, or simultaneously with both.

In order to protect the plant against atmospheric discharges, a lightning arrester has been fitted which has proved very efficient, affording the necessary protection in the case of repeated strokes of lightning.

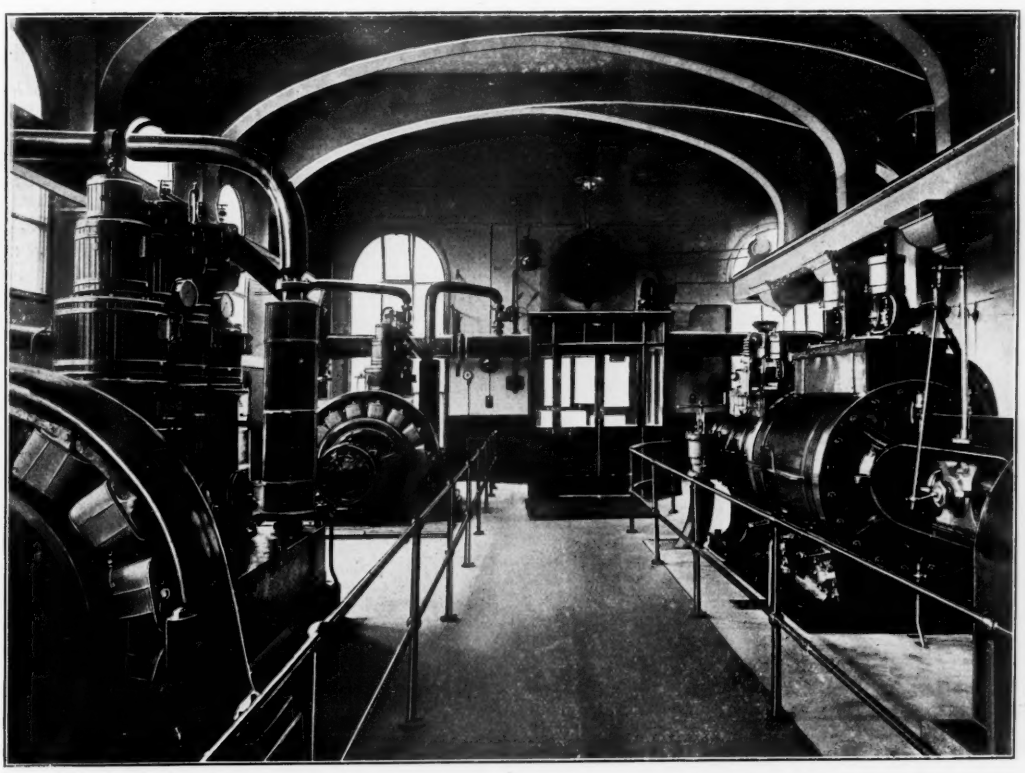
The telegrams transmitted from this station were, a few weeks ago, clearly received on board the North German Lloyd steamer *Bremen* for four hours every day after her departure from Bremen, the messages reaching her successfully even at a distance of about 2,400 km. (1,550 miles), more than half of which lies across country, viz., through the Netherlands, Belgium and France.

As regards the transmission of telegrams over land, a ready communication is ensured between the station of Nauen and St. Petersburg, some 1,350 kilometres distant, both with sounder and inker reception. The possibility of traversing extensive mountain ranges is further demonstrated by the communication obtained between this station and Righi-Scheidegg (Switzerland).

The above results are the more remarkable as the insulation of the ties being not yet completed, operations had to be carried on with only part of the total energy available. These long-distance experiments are, however, to be



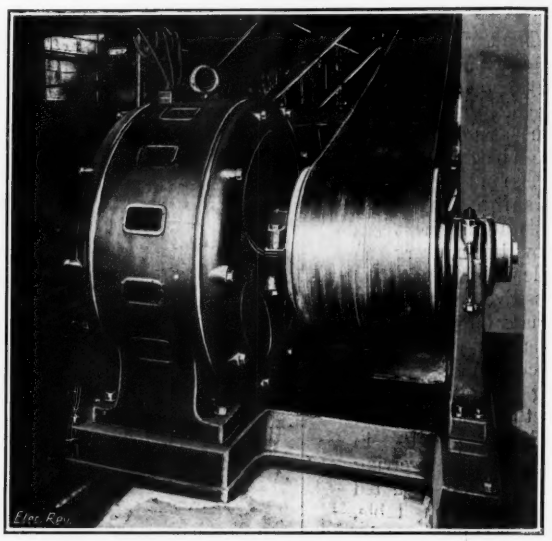
Co-operative Wholesale Society's Dunston Flour Mill: Switchgear for Controlling Milling Plant. (See p. 794.)



Dunston Flour Mill: Displaced Private Electric Lighting and other Plant.

resumed in a few weeks with full energy, when it is expected to cover a range of up to 4,000 km.

The operation of this station has proved exceedingly simple and economical, the services of only two men being required, one of whom takes care of all the rough work, while the other, a skilled telegraphist, transmits and receives the telegrams.

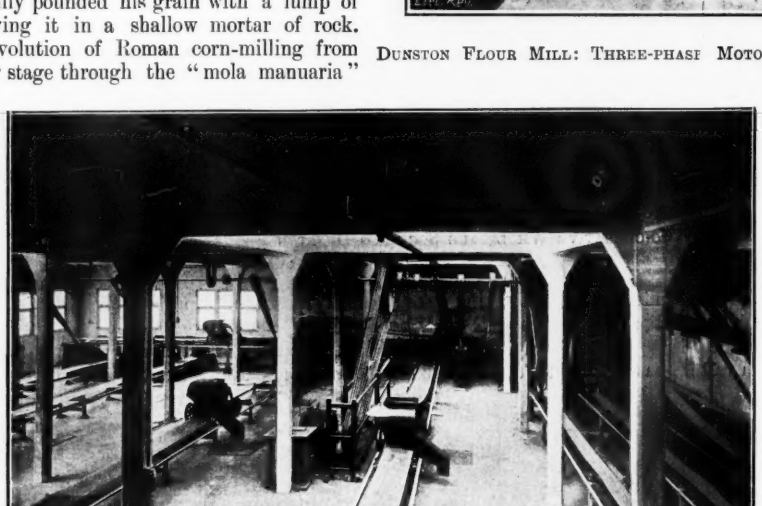


Dunston Flour Mill: Three-phase Motor for a Main Drive.

FLOUR MILLING TO-DAY.

The mournful scribe who wrote that "there is nothing new under the sun" did not live in the electrical age; otherwise he would have modified his statement to the circumspection of a political utterance. The application of electricity is transforming some of the oldest established methods of the world's industry into modes which would render them unrecognisable to the ancients.

The making of flour is one of the hoariest of industries. Primitive man painfully pounded his grain with a lump of hard sandstone, braying it in a shallow mortar of rock. History records the evolution of Roman corn-milling from the pestle-and-mortar stage through the "mola manuaria" or slave mill, to the "mola asinaria" (donkey mill) and the "mola aquaria" or water mill. When the English industrial revolution arrived, the water or wind mill, which had persisted till then, gave place to the steam-driven mill, millstones being replaced by rollers, in many cases of steel with cutting teeth, through which the grain passed. It was reserved to the present year, and to the county of Durham, to witness in England the latest step in the evolution of this ancient industry—the application of electricity to flour milling on any considerable scale.



Dunston Flour Mill: Conveyors and Diverters, Top of Silo House.

The Co-operative Wholesale Society, Ltd., whose head offices of the Newcastle branch are at Manchester, possess a very large and well constructed flour mill and silo at Dunston-on-Tyne, on the banks of the river, facing the large works of Messrs. Armstrong, Whitworth & Co. These confronting industries of peace and war are both very busy, for the flour mill runs 144 hours a week. It is worthy of mention in passing that the whole of the change from steam to electric drive was effected by Mr. W. Fletcher, M.I.M.E., A.I.E.E., the Co-operative Society's engineer, with the collaboration of the engineering staff of the County of Durham Electrical Power Distribution Co., Ltd., without the slightest stoppage of work. This is all the more remarkable because the time elapsing from the decision of the society's directors to scrap their steam plant, to the completion of the change-over, was only three months; the actual time taken in changing over, from the date on which the plant was delivered, was one month, and in order to avoid stoppages, the work was accomplished at week-ends. The substitution of upwards of 2,000 H.P. of electric motive power for steam drives in four week-ends, some of which were of only 12 hours' duration, speaks well for the foresight and smartness of execution shown by those responsible for the change-over. The

Dunston Flour Mill Conveyors and Mixers in the Silo Basement.

whole of the motors in the installation, which are of the three-phase induction type, were supplied by the British Westinghouse Co., who also supplied the high-tension switchgear. The distribution switchgear (low tension) was made by Messrs. Reyrolle & Co. There has not been, from the first run of the first motor installed, to the present date, a single complaint with regard to the operation of the plant.

It is interesting to note the bearing of electricity on the modern manufacture of flour, as exemplified by this mill. A large proportion of the grain comes by river, either in ocean-going vessels or in barges. On the arrival of the vessel at the wharf, portable motors, each of 25 B.H.P., are placed on board and work bucket-type discharge elevators which lift the grain from the hold of the ship to a band conveyor, which in turn carries the grain to the receiving house. This discharge elevator can deal with 100 tons per hour, and is suitable for ships up to 25,000 qr. capacity.

In the receiving house and grain cleaning building are two elevators—one for the ship deliveries, the other for barge shipments—which carry the wheat to two Avery weighing machines dealing with a ton or a ton and a half at a time. The grain then passes through three separators which pick out straws, stones, string, and other large impurities. Meanwhile, fans in the separators winnow the dust into cyclone collectors. Thence the grain passes to the top of the silos or grain-hoppers by bucket elevators, which discharge it into belt conveyors with diverters, which latter pass it into any hopper required. The total capacity of the dirty and clean wheat silos is 40,000 qr. At the bottom of the dirty wheat silos run conveyor bands with Moir mixers in order to secure such blends of grain as are necessary. After passing a battery of separators and graders, cockle and barley cylinders, and scourers, which purify the grain and render it free from foreign matter, the corn is washed with water, then passes through "whizzers"—strong currents of air being blown by electric fans through the corn as it ascends a spiral casing to draw off the water—through conditioners and coolers to the clean wheat silos. On its way thence to the milling machinery it is passed through a brush machine for final removal of dust before going into the grinding bins. The above process can deal with the equivalent of 240 sacks of wheat (20 stones each) per hour, and it is obvious that a considerable amount of power is necessary. The electrical installation in this building consists of four 75-H.P. motors, one 50-H.P., two 35-H.P., and three 5-H.P. motors, principally used for the complete system of belt and bucket conveyors, and for the separators, brushing machinery, &c.

The milling process is that of passing the grain through a long series of roller mills, so arranged that the grain is both crushed and ground to the finest flour. The whole system of cleaning and milling plant was installed by Messrs. T. R. Robinson & Co., of Rochdale, to whom we are indebted for some of the illustrations. The conveyance of the grain to the mills by bands requires two 30-H.P. motors, while in each of the flour mills (which are in exact duplicate) there are two 120-H.P. motors, one 100-H.P., one 75-H.P. and one 30-H.P. motor.

The system of drive throughout the flour mills and grain cleaning house is an adaptation of the usual mechanical mill drive in use before the adoption of electricity. At the change-over the points of application of the power were increased as much as possible, the driving being broken up into smaller sections, reducing, as much as possible, loss of energy by friction. The mills were, until quite recently, equipped with a very complete installation of seven Galloway boilers, two compound tandem engines with condensers for the mill-drive, each of 350 H.P. capacity, a Robey compound tandem engine of 500 H.P. for the cleaning house, two Willans engines coupled to Westinghouse generators for the mill lighting, and one or two motors. In place of this, a sub-station has been built on the premises into which a high-tension three-phase supply at 6,000 volts is delivered from the County of Durham Electrical Power Distribution Co.'s mains. It is transformed to a 440-volt three-phase 40-period supply, on which all the motors are run. The total horse-power of the new installation is about 2,000, and the abolition of an up-to-date steam plant of such magnitude in perfect working order, for a supply from the mains of a power company, shows the solidity of the claims of large electric supply organisations that they can provide power at rates which destroy competition from any other form of power plant, and at the same time make a commercial success of their undertaking.

The Co-operative Wholesale Society has, it will be seen, effected economy in manufacture in two stages: first, in selecting such a locality as Tyneside, where water and rail are so accessible; and second, in utilising the supply of cheap electric power which is to be obtained throughout this area. Their example should be well worth the serious consideration of manufacturers who have any reason to think that, either from the point of view of geographical situation or power costs, their works are not in a position to meet competition with the utmost efficiency.

LIGHTING and POWER NOTES.

(*Concluded from page* 790.)

Manchester.—The Dean of Manchester (Bishop Welldon) is making an appeal for £1,000 to cover the cost of the electric lighting of the Cathedral.

Mansfield Woodhouse.—The Mansfield T.C. has served the U.D.C. with notice of its intention to apply to the B. of T. for an E.L. prov. order.

Morecambe.—The receipts on the tramways for the past year were £8,241, and the expenses £6,465, leaving, with the balance brought forward, £2,177 for distribution. It is recommended that a dividend of 5 per cent. be paid; that £600 be set aside to reserve, and that £477 be carried forward.

Motherwell.—Messrs. David Colville & Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, who are putting in a complete electrical installation for driving their plant, are installing an unusually large battery of the Chloride type, some particulars of which appear among our "Contracts Closed" to-day.

Newport (Mon.).—A L.G.B. inquiry was held on November 6th into the application of the T.C. for a loan of £10,000 for E.L. fittings, motors, &c., viz., £4,000 for motors and appliances; £500 for arc lamps and accessories; £1,000 for heating and cooking apparatus; and £4,500 for wiring consumers' houses. There was no opposition.

Queensland.—Electric coal-cutters are to be introduced at the Blackheath Colliery, Bundamba, Queensland. Mr. R. W. Black, the proprietor, has tested the quality and extent of the seam, and now proposes to work the property on the most up-to-date scientific principles, with new machinery costing £6,000. The intention is to install one McEwan 100-KW. set, which will suffice to drive eight electric coal-cutters, a pump, and a fan for ventilation purposes. It is stated that the present output from the mine is about 350 tons per day, but when the new machinery is installed it can be increased to 1,000 tons per day.—*Australasian Hardware and Machinery.*

Rawtenstall.—A Press report states that the T.C. has decided to generate its own electricity, and has purchased land for the site of a generating station. The Council considers it advisable to buy the Rossendale Valley steam tramways within the borough, and to electrify the system, and a scheme is being jointly considered by Bacup, Rawtenstall and Haslingden whereby the three boroughs may unite for electric tramway and lighting purposes, the Rawtenstall generating site being a central one for the three towns.

Redditch.—The U.D.C. has reduced the price of energy for lighting from 5½d. per unit to 4½d.

Sevenoaks.—The Kent Electric Power Co. has informed the U.D.C. that it intends to commence the laying of E.L. mains in the town during this month.

South Africa.—JOHANNESBURG.—Mr. W. S. Smits, of Johannesburg, acting on behalf of the African Concession Syndicate, Ltd., has made application in the Transvaal to construct and maintain a power line, starting from a generating station at the Jupiter Gold Mine, and traversing various mining properties, for supplying energy thereto, and eastward through the farm Eladsfontein to Boxburg, and westward through the farms Doomfontein, Turffontein, and Laanglaagte. It is proposed to supply three-phase alternating current, at a voltage not exceeding 10,000 volts.

ALIWAL NORTH.—Our Cape correspondent says that an interesting feature of the recent visit of the Governor of Cape Colony to Aliwal was the fact that all the tents, &c., in his camp were fitted up with electric light. The work was carried out in a few hours.

Port Elizabeth.—The Town Council recently discussed the electric lighting scheme with special regard to the financial aspect.

The following statement has been prepared by the Town Treasurer on the instructions of the Finance Committee:—

Total amount expended on the scheme as originally laid down by the electrical engineer is	£94,791
Engineer's estimate was	83,358
Over-spent	£11,433
Estimated cost of completing scheme	5,000
Total additional cost of complete scheme over estimate	£16,433
The total amount of loan	£100,000
Flotation, &c., charges	5,494
Leaving available for the scheme the sum of	£94,506

The total amount expended on the E.L. scheme, we understand, is £100,663, and it appears that instead of having several thousand pounds in hand for working expenses there is at present a small deficit. It was decided not to go to the ratepayers for their sanction to borrow more money at present, so the Council has temporarily transferred £1,500 from the town board fund to the E.L. fund. The electrical engineer has been questioned respecting the state of the steam turbine, which has only been working a few days in the past six months, and which has been under repair for four months, and the answers given are stated to be generally unsatisfactory.

South America.—In view of the lapsing of the contract with the existing company at the end of next year, a new corporation, styled the Empresa Hydro-Electrica, has been formed at La Paz, Bolivia, with a capital of 1,700,000 fr., to supply electricity for lighting, power and traction.

South Lancs.—Messrs. Sackville & Swallow, bleachers, Pendlebury, are adopting electric driving in place of steam. Messrs. Burgess, Ledward & Co., of the Wardley Mills, Walkden, have installed electric motors in their dyeing departments, and Messrs. T. Nuttall & Sons are supplementing steam plant with electrical power at their Worsley Road Mills.

Stratford.—The accounts of the Stratford District Council for the year ended March 31st last, presented to the last meeting of this Council, show that in the Electricity Department the second year's working, after payment of all interest and loan charges, resulted in a net profit of £383. A sum of £911 has been transferred to the depreciation account.

Stroud.—The B. of T. has written to the U.D.C. pointing out that no steps appear to have been taken to carry out the E.L. order granted in 1903, and asking for reasons why the order should not be revoked. When the matter came before the Council on November 7th, it was stated that the Gloucestershire E.P. Co. was taking steps in the matter, and that another company had offered to carry out a scheme. It was decided to reply to this effect, and to apply for an extension of the order.

Surbiton.—On account of the increased demand for energy, the following expenditure within the next year is stated to be necessary:—£7,400 for extension of buildings and machinery, £5,700 for services and meters, and £2,500 for extensions of mains, which, with an amount over-expended on the original loan of £50,000, would bring the additional required sum up to £18,000. The Committee has recommended the sanction to the borrowing of £20,000 for these purposes, and the Council has agreed to apply for the loan.

The Maldens.—The agreement come to between the U.D.C. and the County of London Electric Supply Co. provides that the latter shall apply to the Board of Trade next month, with the support of the Council, for a Provisional Order, the Order to contain a clause for the revocation of the Council's Order of 1904, and a clause enabling the Council to purchase the undertaking at the end of 21 years or any succeeding seven years as a going concern, the price of purchase to be determined by arbitration, failing agreement. The area of supply is to extend from Coombe to Old Malden. The company is to pay the costs of the Council in obtaining its own Order, amounting to £390 odd, and the cost of the revocation of the Order and all expenses incurred by the Council in supporting the application of the company. The money is to be paid on the execution of the agreement, and is to be returned in the event of the company failing in its application through no fault of its own in obtaining the powers sought for. The maximum charge for energy is fixed at 7d. per unit for the first 180 hours' consumption in the winter quarters, and 90 hours' consumption in the summer quarters, and 3d. afterwards; and 2d. per unit for power and heating.

TRAMWAY and RAILWAY NOTES.

Australia.—Sydney.—An important extension of the tramways system is shortly to be commenced, which includes the laying down of tracks in ten or more streets.

Canada.—Welland (Ont.).—Messrs. G. H. Burgar and Waddington are seeking a franchise for the construction of an electric railway in Welland.

Croydon.—It was announced last week that the new section of route between West Croydon and Sutton, *via* Waddon, Wallington, and Carshalton, was to be opened for traffic on Saturday last. The length of the new route is about five miles.

Continental Notes.—Italy.—In the course of a detailed explanation of the difficulties under which the railways, recently acquired by the State, are labouring, Reuter states that electric traction will be widely adopted at Genoa, at Mont Cenis, round Milan, and along the Gulf of Naples.

The Mantova Provincial Council will inaugurate, on the 24th inst., its system of electric tramways running to Asola and to Viadana.

The Provincial Council of Padua has unanimously approved an agreement with the tramway company of Venice for the construction and working of an electric tramway between the two towns. A supplementary generating station will be erected in the neighbourhood of Stanca.

The Director-General of Italian State Railways has recently had under consideration a project for working the heavy trains coming through the Simplon Tunnel over the Porto-Ceresio route into Milan. The Minister has not yet, however, been convinced that these heavy trains can be worked so economically by electrical means on the low tension direct-current system with which the line is equipped, as to warrant dispensing with the steam locomotives.

Germany.—A scheme is under consideration to extend the Elevated and Underground Railway of Berlin, Charlottenburg. From the present Knie terminus a 4½ km. extension to Westend will be constructed with a branch to Wilhelmsplatz. There will be four stopping places.

A project has been conceived for the erection of a hydro-electric station on the Ache River in the Otzt Valley, the energy to be used for the working of the Arlberg section of the State railways. Costly masonry works are involved in the scheme, with an equipment of turbines, &c., and it is expected that power equal to 13,900 H.P. will be furnished.

Glasgow.—The extension of the tramways from Castle Street was opened on Saturday last.

Great Northern Railway.—Our contemporary, the *Railway Gazette*, last week stated that although for some time past the G.N. Railway Co. has been giving the most careful consideration to various systems of electrification, it has not yet been satisfied that any of the proposals put before it warrant the necessary expenditure to make it certain that the present suburban traffic can be hauled without increase in expense. Whether or no this is the case our contemporary has no means of deciding, but it expresses the opinion that the company would not be wise to give up considering this problem merely because those companies which have electrified have not published their results, and further goes on to say that it has before it the preliminary estimates and details of the actual results since obtained on these lines, and if the G.N. Co. only goes to the right source for its advice, it will find the benefit of a scheme prepared in the light of actual experience. At least it can satisfy itself as to what electricity really can or cannot do for it.

Huddersfield.—The T.C. has decided to apply to the B. of T. for a prov. order for the extension of the electric tramways from Crossland Moor terminus to Crossland Hill.

Japan.—The *Board of Trade Journal*, quoting from a Japanese paper, says that two important electric railway proposals for Kobe are now under consideration by the Government, whose official sanction thereto is expected shortly. The first is that of the Kobe City Electric Railway for permission to connect the Hanjin and the Kobe electric lines, and the second is an application by the Hanjin Electric Railway Co. for permission to extend its line to the American Hatoba. An agreement has already been arrived at between the Osaka municipality and the Hanjin Electric Co. concerning the connection of the latter line with the Osaka Harbour electric line.

London.—L.C.C.—The members of the Highways Committee travelled on a portion of the new electrified Northern system on Saturday last from the Angel, Islington, to Highbury Station.

At last week's meeting the joint report of the Finance, Highways and Improvements Committees on street widenings in connection with tramways was presented and postponed for further consideration, as stated in our last issue. The report went on to say:—"With regard to street widenings along the main traffic routes in the county, we are of opinion that many such widenings on the lines of existing or projected tramways are such as would sooner or later be carried out quite apart from the fact of the Council being the owners of the tramways. At the same time we are impressed with the fact that such widenings are often expedited in the interests of the tramways, and its seems to us that some charge against the tramways account may not unfairly be insisted upon as a recognition of the improvements being carried out at an earlier date than would otherwise be the case. It would not, we think, be unreasonable in such cases, to require that the charge against the tramways account should bear some relation to the interest payable on the capital required for the improvement, for the period by which the improvement may be presumed to have been anticipated. For example, suppose that an improvement is carried out 10 years earlier than it would have been if there were no tramway to be considered. The money has to be found for the improvement 10 years earlier than it otherwise would have been, and the present value of the interest payable during this period at, say, 3½ per cent., is equal to about 29 per cent. of the capital cost of the improvement. If seven years were the period by which an

improvement were thus anticipated, the interest charge would work out at 21½ per cent. The mean of these two percentages is 25 per cent., and we take that figure for present purposes. There are, however, other considerations, which, in our opinion, go to show that the charge to the tramways account of such a proportion of the cost would operate too favourably to the improvement accounts. The first is that the longer an improvement is delayed, the more expensive it will probably be in the majority of instances, and any saving through the earlier carrying out of the improvement may therefore be taken in reduction of the amount chargeable to the tramways account calculated as above. Again, while it may be true that but for the tramways the improvement would not have been carried out so soon, there can be no question that when the improvement has been carried out, benefits immediately begin to accrue in the shape of increased public convenience, and no doubt, in many cases, increased rateable value. The value to be given to these considerations cannot be accurately measured, and would, no doubt, vary in different cases, but for the purposes of a general rule it would, we think, be sufficient to reduce the percentage arrived at above by one-half, which would give as the charge against the tramways account in respect of the cost of the improvement, a percentage of 12½, or one-eighth of the estimated net cost of the improvement. We are of opinion that such a charge should be made in acknowledgment of the improvement being expedited, and that, as a general rule, it should be a fixed sum, calculated as above suggested, and not a proportion of the actual net cost. This would simplify the keeping of the accounts. This rule would apply only to those cases where it is considered that the street widenings are county improvements along main traffic routes which would be carried out sooner or later to meet the demands of through traffic, quite irrespective of the question of tramways. In any case were an improvement is undertaken specially on account of tramways, we think that the whole cost should be charged to the tramways account, and that where an improvement is undertaken as being desirable and urgently needed apart from any question of the construction or reconstruction of tramways along the thoroughfare, there should be no charge against the tramways account. We think that the duty of advising the Council to which of the above-mentioned classes any particular improvement belongs should be delegated to the Improvements Committee." The joint report submits recommendations in the direction indicated, and suggests that the standing orders should be amended accordingly.

The new section of tramway which has been laid between Camberwell Green and Lordship Lane was opened for traffic on the 14th inst.

The Highways Committee, at Tuesday's meeting of the L.C.C., asked for authority to communicate with the B. of T. and the Camberwell and Lewisham Borough Councils with a view to the adoption of the overhead trolley, instead of the underground conduit, system on the authorised tramways from Woodwarde Road *via* Lordship Lane and London Road, to Dartmouth Road, Forest Hill; and from Grove Lane to Stewart Road, Peckham.

Hammersmith and City Railway.—One or two of the new joint stock multiple-unit trains of the Great Western and Metropolitan Railways have been recently put into public service between Hammersmith and Aldgate, and we believe they are running satisfactorily.

Manchester and Oldham.—An arrangement between Manchester and Oldham for a through tramway service is understood to have been completed. The main obstacle has been with regard to some of the intervening local authorities. January 1st next is mentioned as the date when the through service will begin.

Panama.—The government of the capital district of Bogota has granted a concession for 60 years for an electric tramway, with exclusive rights to the streets of Bogota and the roads of the district, to the Bogota Street Railway Co. of New Jersey.

Rhyl.—A scheme has been laid before the Council for the construction of an electric light railway to encircle Rhyl and extend to Prestatyn along the sea front. The Council is prepared under certain conditions to give its sanction, one stipulation put forward being that the section between Rhyl and Prestatyn should be completed first.

Wickham (Durham).—At a meeting of the U.D.C. on the 8th inst., it was reported that a letter had been received from the Gateshead and District Tramways Co. offering to pay £400 if the Council would release the company from their agreement, and consent to the abandonment by the company of the extension of the tramways from the Cross Keys to the Dun Cow, Dunston. After considerable discussion on the matter, it was decided not to accept the amount offered, but refer the subject to the Tramways Committee.

TELEGRAPH and TELEPHONE NOTES.

Australian Telephones.—The proposal to reorganise the telephone rates aroused violent opposition some time ago, on much the same basis of ignorance and parsimony as that on which the municipal telephony movement was founded in this country. The Government proposed to adopt the toll system, in place of the inequitable unlimited rates previously in vogue. The latest report is that the minimum charge is to be £5 per annum in Sydney, Melbourne, Brisbane and Adelaide, and £4 10s. in Perth and Hobart, with six free calls per day, or about 2,000 per annum. In country districts the rates will be £4 for exclusive service, and £3 for a two-party line. Beyond 1,000 calls per half-year, the charge will be 1d. for two; from 2,000 to 3,000, 1d. for three; above 3,000, 1d. for four. Until February next new subscribers will have the choice of the toll system or the flat rate; after that there will be no more new flat rate subscribers, but those already enrolled will not be disturbed. New instruments will be introduced by degrees all over the Commonwealth.

The rates seem to be extremely low, and we fear the Government will find is difficult, if not impossible, to make ends meet.

Bahamas.—The Annual Colonial Report for the Bahamas 1905-6 states that the revenue of the telegraph department was £1,520, and the expenditure £558. In 1904 the revenue was £1,220, and the expenditure £573. A total of 4,419 messages passed over the Nassau-Florida cable, of which 477 were to and from Great Britain and 3,137 to and from other countries. The number in 1904 was 3,311.

A telephone exchange is now being set up in the city of Nassau.

Cape to Cairo Telegraph.—An interesting article, well illustrated, by Mr. F. A. Talbot, appears in the November issue of the *World's Work*. A brief historical summary of Mr. Cecil Rhodes's great scheme is given, after which follows a graphic account of the difficulties overcome by the engineers in carrying out the work. Only 450 miles, from Ujiji to Port Victoria, remains to be covered, and as this section is exceptionally rugged, it is probable that wireless telegraphy will be used to span it.

Constantinople-Fao.—The telegraph line between Constantinople and Fao in the Persian Gulf is to be doubled, the new line following a route less difficult than that of the existing line.

Egypt.—Considerable progress is being made in the construction of telephone lines in Egypt, and during the year 850 lines which are in hand will be completed. There are at present 1,036 lines open, 457 of which were added during the last year.

Liverpool.—Electrical sound-transmitting apparatus of an interesting character is being obtained by the Mersey Docks and Harbour Board, at a cost of £900, from the Submarine Signal Co., of Boston. For about three months past, sound-transmitting apparatus of the kind in question has been in use experimentally on the North-West Lightship, in Liverpool Bay, and between the lightship and certain steamers entering and leaving the Mersey. Each lightship fitted with the apparatus will be allotted a special index number, which will serve as the identifying number to vessels, the number of sounds heard, indicating the number borne by the lightship, and her presence in the locality, and consequently the whereabouts of the vessel hearing the sound. Within a distance of eight to nine miles of the lightship, the sounds of the bell are audible on a vessel having the receiving apparatus. The sounds of the bell can be distinctly heard on vessels which have no receiving apparatus, by the simple expedient of placing the ear against the skin of the ship at a point below the water line—inside, of course. In such a case, the sound of the bell can, it is said, be heard at three times the distance at which an ordinary fog-horn can be heard. During the three months that the bell on the North-west Lightship at Liverpool has been in use, it has been found to work so satisfactorily that the Cunard and White Star Shipping Companies have had their steamers on the Liverpool and New York service provided with apparatus for "picking up" the sounds. The Mersey Docks and Harbour Board have purchased a new and duplicate apparatus for the lightship for the sum stated. A full description of the apparatus has already appeared in our pages.

The Admiralty has also been making official trials of the system, on the armoured cruiser *Antrim*, the bell, operated by pneumatic power, was carried by the torpedo gunboat *Spanker*. The experiments were very successful, in spite of rough weather, the bell being audible at a distance of 16 nautical miles, and its position being accurately localised. The employment of the system in connection with submarines is under consideration.

New Cable.—The Danish Northern Telegraph Co. has obtained from the Russian Government a concession for laying cables from St. Petersburg to Denmark, *vid* Libau.

Paisley.—An outbreak of fire in a building adjoining the National Telephone Co.'s exchange last Saturday brought down a large number of overhead wires and disorganised the whole service. Steps were taken immediately to restore the connections.

South America.—The German Consul-General at Valparaiso reports that A. E. Price, of that city, has obtained a concession for the installation and working of telegraph lines between Santiago and Iquique, with various sub-stations and branches.—*B. of T. Journal.*

Spain.—The telegraph system during the year, 1904, was represented by 28,809 kilometres of aerial line, 175 of underground cables and 3,290 kilometres of submarine cable, total, 32,274 kilometres of line, and 76,323 kilometres of wire. The *personnel* was increased in 1904 by 1,180 to 4,190; the junior staff accounted for the greater part of the addition, the superior employés remaining unaltered at 186. The system comprised 1,645 offices, 883 belonging to the Government, 379 to railway companies open

to the public, and 154 to municipalities. Of the above 27 were opened during the year. Inland telegrams were fewer than in the previous year by 19,689, there being altogether 3,529,689, of which 2,955,125 were private, 386,155 official and 188,409 service messages. During the year 577,738 telegrams were sent to foreign countries and 653,637 were received from them, while 186,697 passed in transit, making the international traffic altogether 1,418,072 telegrams. This is an increase over 1903 of 124,161 telegrams, the number of words paid for being 17,090,629, or an increase of 1,288,955 over the same period. The telegraphic system, therefore, handled a grand total of 4,947,761 telegrams. The inland service produced a revenue of 5,552,153 pesetas (about £222,086), a decrease over 1903 of 77,410 pesetas (about £3,096). This loss was, however, covered by the increase of receipts on account of the international service, which produced 2,460,728 pesetas (about £71,741), or an increase of about £2,957. The total revenue from the telegraph and telephone systems was 8,994,085 pesetas (about £359,763), and the expenses provided for in the Budget were 9,263,531 pesetas (about £370,541).

There were 18,575 telephone stations and call offices in 1904. Barcelona had 3,010 subscribers; Madrid, 2,383; Bilbao, 1,275; Valencia, 1,097; Sabadell, 439, and Las Palmas, 171.—*Journal Télégraphique.*

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Cayenne-Pinheiro	Aug. 18, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Dominica-Martinique	May 7, 1902	..
Guadeloupe-Martinique	Aug. 29, 1906	..
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	..
Curacao-Coro / Curacao-La Guayra / Curacao-Maracaibo	Closed.. Jan. 12, 1906	..
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904	..
Garachico-Santa Cruz	July 12, 1906	..
Las Palmas-Arecife	Aug. 18, 1906	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..

Telephone Charges.—In answer to a question in Parliament, the P.M.G. recently issued the following statement:—"The telephone calls made by subscribers to the larger exchanges in London are recorded by means of meters attached to the lines. At suburban exchanges a written record of calls is made by the operators. Calls are not recorded against subscribers until effective communication has been established, and no charges are made if the distant subscribers are engaged, or fail to answer, or if their lines are out of order. Strict supervision is exercised over the recording work of operators. Whenever there is an account to render it is rendered monthly; but as the annual subscription paid by message rate subscribers in London includes a minimum payment for 360 calls, it is only when that number is exceeded that an account becomes necessary in the case of exchange calls. In the case of deposits for trunk calls and telegrams, accounts of any charges are always rendered monthly. I have no reason to think that the present system of rendering accounts gives rise to dissatisfaction."

Wireless Telegraphy.—A wireless telegraph service was inaugurated on September 1st last between Derna, Tripoli and Guelemich, about 60 kilometres south of Makri, on the coast of Asia Minor, to the east of the Island of Rhodes and about 392 nautical miles from Derna. The speed of the service is 10 words per minute.—*Journal Télégraphique.*

Work is in hand on the establishment of a system of wireless telegraphy between Mazatlan, Mexico, and San José del Cabo, Lower California.

CONTRACTS OPEN and CLOSED.

OPEN.

Accrington.—November 30th. Cables, troughing, bitumen; pole-work, overhead work, switch-pillars; electric tramcars complete, for the Corporation tramways. See "Official Notices" November 9th.

Barry Railway Co.—November 23rd. Stores and materials for one year, including electric incandescent lamps, wires and sundries. Forms, samples and patterns, &c., at the Storekeeper's Office, Broad Street, Barry.

Cape Town.—November 28th. Tenders will be received by the Chairman of the Tender Board, Cape Town, for the supply of dry cells, oblong, 3 in. by 1⅞ in. by 6 in. high, regenerative or non-regenerative type, for the period February 1st to October 31st, 1907.—*Board of Trade Journal.*

Dublin.—November 19th. Stores for the Dublin United Tramways Co., Ltd. See "Official Notices" November 2nd.

Hackney.—November 22nd. One 1,500-KW. steam dynamo with accessories. See "Official Notices" October 26th.

Rome.—December 31st. The Municipal Council is inviting tenders for new street railways at Rome. Apply to the "Sindaco di Roma."

Saltburn-by-the-Sea.—Storage battery for the Cleveland Trust, Ltd. See "Official Notices" to-day.

Spain.—November 20th. The municipal authorities of Aviles are inviting tenders until the 20th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Aviles, Spain.

Spain.—December 6th. The *Gaceta de Madrid* of November 8th contains a notice inviting tenders, which will be opened 30 days from the above mentioned date, at the office of the Director-General of Posts and Telegraphs, Madrid, for laying a submarine cable between Barcelona and Palma (Majorca), in accordance with conditions and specifications set forth in the *Gaceta*. Payment will be made by the Spanish Government in the form of a certain number of annual payments of 81,551 pesetas (about £2,939); if the amount of cable required is that estimated, viz., 156 miles, these payments will be made for not more than 13 years—13 payments. If this estimate should prove incorrect, payments will be made for a greater or lesser number of years, according to the amount required. The work will be awarded to the tenderer requiring the least number of annual payments, provided that the conditions of tender are fully complied with. A copy of the *Gaceta* can be seen at the offices of the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Sunderland.—November 30th. Four 350-KW. rotary converters, static transformers, and high-tension switchgear for same. See "Official Notices" to-day.

CLOSED.

Brandon.—The U.D.C. received the following tenders for the installation of the E.L. at Brandon Colliery:—

Reid, Ferens & Co., Newcastle	(accepted)	£642
C. Pullan, Bradford		735
G. H. Armstrong, Chester-le-Street		742
W. Fletcher, Newcastle		670
Hind & Son, Stockton		792
W. T. Glover & Co., Manchester		1,172
Northern Electrical Engineering Co., North Shields		798
British Insulated and Helsby Cables		959

Bursiem.—The T.C. has accepted the tender of Callender's Cable & Construction Co., Ltd., for the supply of 1,000 yards of cable, at £92, and that of Messrs. Dick, Kerr & Co. for a new generating set, at £1,842.

Derby.—The T.C. has accepted the tender of Messrs. C. A. Parsons & Co. for the supply of two 1,000-H.P. turbines for the electricity works, at £10,686.

London.—The Metropolitan Railway Co. has accepted the tender of Messrs. Rowland Carr & Co, of London, for the next 12 months' supply of cast-iron socket pipes and fittings.

L.C.C.—The Fire Brigade Committee of the L.C.C. received the following tenders for wiring the new station which is being erected in Cannon Street, E.C.:—

L. W. Sunderland & Co.	(recommended)	£257
F. J. Coleby & Co.		265
Frank Suter & Co.		300
Durell & Co.		323
Oliver Clark & Co.		326
G. E. Taylor & Co.		336
Roger Dawson, Ltd.		340
J. O. Grant & Taylor		351
Barlow & Young		413
J. Defries & Sons		445
John Barker & Co.		445

The Highways Committee propose to extend a contract with the General Electric Co. so as to include the supply of additional switchgear for the Battersea tramway sub-station, at a cost not exceeding £500.

ISLINGTON.—The Lighting Committee has provisionally accepted the tender of Messrs. S. A. Blackmore & Co. to supply from 2,000 to 3,000 tons of Griff nuts and small coal for the generating station, at 3s. 11d. at the pit's mouth, or 9s. 11d. per ton delivered. It has also accepted the tender of Messrs. Phillips & Co., Ltd., to supply 2,000 tons of Griff nuts and small or Stockingford coal, at the following prices:—Griff nuts and small, 3s. 11d. at pit's mouth, 9s. 11d. delivered; Stockingford, 3s. 6d. at pit's mouth, and 9s. 6d. delivered. Only three firms tendered.

Mersey.—The Mersey Docks and Harbour Board has accepted a tender from Messrs. Johnson & Phillips, Ltd., for an electric light installation on the north quay of the Canada, No. 3 Branch Dock.

Merthyr Tydfil.—The B.G. has accepted the tender of the Pearson Fire Alarm Co. for the installation of electric fire alarms at the workhouse, at £185, with an annual rental of £19 14s. for ten years, and half that sum afterwards.

Motherwell.—The Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester, have received from Messrs. David Colville & Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, an order for 115 "C.W. 14" cells with a capacity of 2,380 ampere-hours, to work in series with a reversible shunt regulating booster, with a momentary capacity of 2,400 amperes, and a switchboard for controlling the combination, in connection with the electrical equipment of their steel-works.

Newport.—We stated last week that the Corporation had accepted the tender of Messrs. William Sanders, of Wednesbury, subject to the borough electrical engineer being satisfied with it. We now learn that the tender has been finally accepted.

Stalybridge.—The Joint Tramways and Electricity Board has accepted the tender of the British Westinghouse Co., Ltd., for the supply of switchgear for the new turbine set.

Walsall.—The T.C. on November 9th accepted the tender of Messrs. T. Parker, Ltd, for the supply of a transformer for the Pleck sub-station, at £175.

West Bromwich.—The T.C. on November 9th accepted the tender of Johnson & Phillips, Ltd., for the supply of cable.

FORTHCOMING EVENTS.

To-day's Events (Friday, November 16th).—Northampton Institute Engineering Society. Mr. T. Germann on "Telephone Sub-station Instruments."
At 8 p.m. Institution of Mechanical Engineers. Mr. Thos. Clarkson on "Steam as a Motive Power for Public Service Vehicles."
At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). Address by Dr. Marchant on "The Training of an Electrical Engineer."

Saturday, November 17th.—At 10.30 a.m. I.E.E. (Students). Visit to the L.C.C. Greenwich Generating Station. The Northampton Institute Engineering Society will also visit the same station.
Monday, November 19th.—Institute of Marine Engineers. Meeting.
Tuesday, November 20th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). At Midland Hotel. Address by the Chairman, Mr. T. L. Miller. Address will be followed by a smoking concert.
At 8 p.m. Institution of Civil Engineers. Paper to be further discussed, "Single-Phase Electric Traction," by Mr. Chas. F. Jenkin.
Wednesday, November 21st.—At 8 p.m. Institution of Electrical Engineers (Birmingham). At the University. Address by the Chairman, Mr. R. A. Chattock.
Thursday, November 22nd.—At 7.15 p.m. Institution of Electrical Engineers (Leeds). At the University, Sheffield. Mr. A. Raworth on "Regenerative Control of Electric Tramcars and Locomotives."
At 8 p.m. Institution of Electrical Engineers (London). Prof. J. Epstein on "Selection and Testing of Materials for the Construction of Electric Machinery."
At 8 p.m. Institution of Electrical Engineers (Dublin). At Dublin Royal College of Science. Address by Mr. A. W. Whieldon, chairman.
Friday, November 23rd.—At 5 p.m. Physical Society, Royal College of Science. Prof. J. A. Fleming on "The Electrical Radiation from Bent Antennæ." Dr. R. S. Willows on "The Electrical Resistance of Alloys."
Saturday, November 24th.—Northampton Institute Engineering Society. Visit to the City and South London Railway.
Institution of Electrical Engineers (Manchester Students). Visit to the Stuart Street Generating Station.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, November 19th.—"A" Company, recruits' infantry drill, 6 p.m.; technical drill, 7 p.m.
Tuesday, November 20th.—"B" Company, technical drill, 6 p.m. Medical inspection for recruits, 7 p.m.
Thursday, November 22nd.—"C" Company, technical drill, 6 p.m.
Friday, November 23rd.—"D" Company, technical drill, 6 p.m.

J. H. Phillips, Captain E.E.,
For O.C.E.E.R.E. (V.).

Electrical Contractors' Smoking Concert.—The Electrical Contractors' Association (Inc.), London section, is holding a smoking concert at Frascati's Restaurant (York Room), on Thursday, November 29th, at 8 o'clock p.m.

NOTES.

The "Electrical Review" and the Electrical Trades.—We want a word with the electrical trades—it directly concerns our relations with them. We have said it before, but it seems to be the sort of thing that must be stated again and again. And we want to say it at the present juncture in the hope that it may prevent a good deal of unnecessary correspondence between ourselves as editors, and the members of the electrical industry. Far too frequently for our liking, and more especially of late, we receive letters from firms of some standing, asking what our charge will be for the insertion of an editorial descriptive notice, either of their new manufactures, their works, or their trade movements. Let us say emphatically, and to everybody concerned, that we have never admitted any matter to our editorial pages in return for payment, nor do we intend to do so. It is absolutely opposed to our ideas of fair journalism. We had hoped the whole trade knew our principles by this time—but in view of our experience, and of what is happening elsewhere, we feel it incumbent upon us to make this very plain statement.

Utilisation of Water Power in Sweden.—A Stockholm correspondent, in recalling the fact that Sweden recently commenced to utilise the enormous native water powers to a greater extent for industrial purposes, expresses the opinion that the time is not far distant when electrical working will be introduced on a considerable mileage of the railways. The only question before embarking upon the work is to receive the final results of the experimental work which has been in progress for a year. At the present time a power station is being established at the Gullspang Fall, which is expected to yield at least 150,000 H.P., and to supply a large portion of the centre of Sweden with energy for industrial and illuminating purposes. The expenditure on this station is estimated to amount to 5,000,000 crowns. It is thought that when the station is completed it will be the means of reducing the foreign coal bill by a sum of about 1,500,000 crowns per annum.

Local Government Contracts and Secret Commissions.—The Local Government Board has sent a circular letter to the various local governing authorities throughout the kingdom drawing attention to provisions of the Prevention of Corruption Act, 1906, which will come into operation on January 1st next. The communication points out that the Act defines as misdemeanours various forms of corrupt transactions in which agents may be concerned, and prescribes penalties for the commission of these offences. A person serving under the Crown or under any corporation, or any municipal borough, county or district council, or any board of guardians is by Sub-sec. (3) of Sec. 1, an "agent" within the meaning of the Act, and for the purposes of the Act the expression "agent" includes any person employed by or acting for another, and the expression "principal" includes an employer [Sec. 1 (2)].

Electric Shock Fatality.—A painter engaged on the Angelo Gold Mine, at Johannesburg, was killed last month, as the result of coming in contact with wires carrying current at 3,000 volts. It appears that he had placed his paint and brushes temporarily in a distribution box, and when taking them out, he accidentally touched the wires.

Educational Notes.—Association of Teachers in Technical Institutes.—The annual general meeting was held at the Birkbeck College on Saturday, October 27th, Mr. Lineham, M.Inst.C.E., president, in the chair. The report of the Council for 1905-6 was received and approved, and it was resolved that in view of the generally inadequate provision made in the present scholarship schemes of local educational authorities for the needs of scientific, technological, and trade students, the local branches of the Association be instructed to consider what amendments of local scholarship schemes are necessary to meet the needs of such students, and to press such amendments upon the Local Educational Authority with a view of remedying the defects indicated; also that the attention of the technological branch of the Board of Education be drawn to the desirability of recruiting the staff of inspectors only from those with experience in technological teaching. Mr. V. A. Mundella, M.A., B.Sc. (head of the Physical and Electrical Engineering Department, Northern Polytechnic, Holloway, N.) was elected president for 1906-7. Mr. John Wilson, of 37, Park Mansions, S.W., is the hon. secretary.

Glasgow and West of Scotland Technical College.—We have received the annual report of the 110th session which states that the first section of the new buildings was occupied in September last year. The section in question constitutes the greater part of the scheme, and the whole cost of it has already been discharged. The Secretary for Scotland formally opened the buildings in December last. The Secretary and Director, and the Professor of Mechanics, visited Canada and the United States to inspect the engineering laboratories there, and a very complete equipment will shortly be housed in the Mechanics and Hydraulics Laboratory and the Motive Power Engineering Laboratory. The number or students enrolled for the current session was 5,012, of whom 535 were day students. The evening students show a slight decrease, owing to the operation of an agreement with the local School Boards, whereby the gover-

nors have ceased to conduct elementary classes in mathematics, engineering drawing, and building construction, rightly confining their attention to more advanced work. The report gives full particulars of the work of the session, and of the extremely interesting observations of the deputation to America.

Institution Notes and Lectures.—Institution of Electrical Engineers (Manchester Students).—The following is a list of the papers and visits arranged for the 1906-7 Session:—

Meetings.

November 16th.—Address by Dr. Marchant on "The Training of an Electrical Engineer."
November 30th.—Mr. L. H. A. Carr on "Trolley *v.* Conduit."
December 14th.—Mr. P. Löbel on "Design of Central Stations."
January 11th.—Mr. F. Shaw on "Electric Lamps."
January 25th.—Mr. E. G. L. Mosley on "Adaptability of Electricity to Mines."
February 9th.—Annual Dinner.
February 15th.—Mr. W. Browning on "Notes on Electrical Conductivity."
March 8th.—Paper to be announced later.
March 22nd.—Messrs. K. L. Shoolridge and D. G. Pennington on "Water Power as applied to the Generation of Electricity."
April 19th.—General Meeting.

Visits.

November 24th.—Stuart Street Generating Station of Manchester Corporation.
December 1st.—Lancashire Electric Power Co.'s Generating Station.
January 5th.—Probable visit to the works of the Belsize Motor-Car Co., Clayton.
January 19th.—Probable visit to Messrs. Dick, Kerr & Co.'s works at Preston.
February 2nd.—Works of Messrs. Mountain & Gibson, Bury.
February 16th.—Liverpool and Southport Electric Railway.
March 2nd.—Salford Corporation Generating Station, Pendleton.
March 16th.—Widnes and Runcorn Transporter Bridge.
April 6th.—Probably to Messrs. W. T. Glover's Cable Works, Trafford Park.

Institution of Electrical Engineers (London Students).—The visit arranged to be paid to the Amalgamated Press, Ltd., on November 24th, has been postponed.

Institution of Civil Engineers.—On Tuesday last week the President, Sir A. B. W. Kennedy, F.R.S., delivered his inaugural Address; and last Tuesday Mr. C. F. Jenkin read a paper on "Single-phase Electric Traction."

Royal Institution.—A Christmas course of lectures, adapted to a juvenile auditory, will be delivered by Mr. W. Duddell on "Signalling to a Distance; from Primitive Man to Radio-Telegraphy." (Experimentally illustrated.) The dates of the lectures are December 27th, 29th, 1906; January 1st, 3rd, 5th and 8th, 1907, at 3 o'clock.

Faraday House Old Students' Association.—The first smoking concert of the above Association will be held at Frascati's (York Rooms), on Friday, November 23rd, at 8 for 8.30 p.m. Any members who have not received tickets are requested to communicate with the secretary, 66, Southampton Row.

Illuminating Engineering Society (New York).—The November meeting of this society was held on the 9th inst. at the Edison Auditorium, when papers were read by Mr. F. N. Olcott, Major E. L. Zalinski and Mr. P. S. Millar on "Fixture Location and Residence Lighting," "Fixture Design and Location," and "Location of Lamps and Illuminating Efficiency," respectively.

The P. and O. Batti-Wallah's Society.—A smoking concert was held on Wednesday evening last at the Holborn Restaurant.

Royal Society.—The following papers were to be read at the meeting held yesterday afternoon:—"The Effect of Temperature on the Activity of Radium and its Transformation Products," by Dr. H. L. Bronson, communicated by Prof. E. Rutherford; "The Photo-Electric Fatigue of Zinc," by Mr. H. S. Allen, communicated by Prof. H. A. Wilson.

Society of Arts.—The following papers have been arranged to be read before the Society during the 1906-7 Session:—

Wednesday, November 28th.—At 8 p.m. Mr. John W. Gordon on "Patent Law Reform." Sir William H. Preece, K.C.B., will preside.
Tuesday, December 4th.—At 4.30 p.m. The Hon. Sir Lewis L. Michell on "The Cape to Cairo Railway."
Wednesday, December 5th.—At 8 p.m. Colonel Sir Charles M. Watson, K.C.M.G., on "The Metric System."
To be read after Christmas.—"Smoke Prevention in Factories," by Mr. J. B. C. Kershaw.

The L.C.C. Power Scheme.—It is stated in Wednesday's *Evening Standard* that there is a prospect of the L.C.C. scheme being considerably modified. The leaders of the Progressive party are being urged by members on their own side to drop the idea of the Council working the undertaking in view of the great opposition to the scheme as it stands at present, and the difficulty that must be experienced in raising the money. "The approach of the Council elections has also something to do with the proposed changes. As an alternative to the present scheme, it is suggested that the Council should build the generating station, and lease it to a private corporation, which would lay the mains, and develop the undertaking on ordinary business lines. As the continuance of the lease would be made conditional on the private corporation's complying with rules for fully safeguarding the interests of the public, it is held that the Council would secure in this way all the control that was necessary without running any financial risks. The new scheme is said to be in accordance with the views of the President of the Board of Trade, and to have the support of Lord Welby and other leading Progressives. The compromise would also be acceptable, it is believed, to the Municipal Reformers provided that the tenders for the generating station were thrown open. The present generating station at Greenwich is already obsolete, although it is not quite finished. In the event of the leaders of the party refusing to modify their plans, the scheme will be attacked by a number of Progressives as well as by the Municipal Reformers at the coming elections, and should the Municipal Reformers be returned in a majority to the new Council there would still be time either to drop or modify the Bill, which will not reach its second reading until the elections are over. A strong effort is to be made, however, to come to a compromise on the lines of the new scheme."

Appointments Vacant.—Junior electrical shift engineer for East Sussex County Asylum; electrical engineer for His Majesty's Mint at Calcutta; charge engineer for Newport (£2).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—The following increases of salary have been granted by Derby T.C.:—Mr. W. C. Pinn, station superintendent, from £170 to £185 per annum; Mr. G. R. Copping and Mr. Lake, charge engineers, from 40s. to 45s. per week.

The Heston and Isleworth U.D.C. has promoted Mr. J. Arthur Sykes to be deputy electrical engineer and manager at an increased salary, as an appreciation of services rendered.

The Cheltenham T.C. has appointed Mr. Ardasser, of Swansea, as charge engineer at the electricity works.

The Burslem Town Council has resolved that the services of Mr. Ashton Bremner, borough electrical engineer, be retained for another year, at £400 per annum, to include all claims for remuneration for work completed or now in progress. Alderman Malkin said that Mr. Bremner was originally engaged at £200 a year to carry out a scheme for laying down a gas-driven plant, which had then been agreed upon. They, however, decided to abandon that scheme, and instructed Mr. Bremner to draw up and carry out an entirely new scheme. In consideration of that, they voted him an additional £200 a year for three years, making his total remuneration £400 a year. That extra £200 a year was based upon a commission of 3 per cent. on the total estimated outlay of the scheme. If they had had to give the work to an outside engineer, the commission would have been fully 5 per cent., so that they had really effected a saving of £400. They were now spending a further £7,800 in additional plant, £5,500 being in respect of the extension to Tunstall, and £2,300 in respect of the new generating set—and the additional amount they were proposing to pay Mr. Bremner was less than 3 per cent. on that outlay. He pointed out that they were not proposing to give Mr. Bremner anything beyond what he had had for the last three years, namely, £400 per annum.

Tramway Officials.—Ilford U.D.C. has appointed Mr. A. Woolstencroft, of Oldham, as tramways superintendent at a salary of £200 per annum.

General.—Mr. W. H. Sisson has been appointed engineer to the Kearsley Spinning Co., Ltd., whose spinning mills are among the first in this country to be driven electrically (three-phase). For several years Mr. Sisson was engineer and manager to the Witney Electric Supply Co., Ltd., and for the last two years he has been chief assistant electrical engineer to the Mersey Docks and Harbour Board. The Kearsley plant comprises two 1,000-h.p. steam turbines (A.E.G.) with three-phase alternators, and the following motors: four of 450 h.p. each, three of 150 h.p., and a number of 50 h.p. and less, also electrically driven condensing plant, and a 100-h.p. d.c. lighting set.

Mr. Andrew McPherson, of the Electric Construction Co., Ltd., Wolverhampton, has been appointed to the position of assistant engineer at the Government Electric Lighting Station at Lagos.

The Manchester City address of Mr. William Cramp, consulting engineer and designer of electrical machinery, is now Atlantic Chambers, Brazennose Street, Manchester.

We learn that Mr. George Stevenson, A.M.I.E.E., late electrical engineer to the Carron Co., has now severed his connection with that firm and joined the staff of the British Thomson-Houston Co., at their Glasgow office.

Mr. Patrick Hamilton, B.Sc., A.M.I.C.E., M.I.E.E., has severed his connection with Messrs. Kelvin & James White, Ltd., of Glasgow and London, with whom he has been associated for many years, having acted as London manager since the inauguration of the London office. He has now opened offices at 53, Victoria Street, Westminster (Telephone No. 1855 Victoria), to which address all communications should be sent.

NEW COMPANIES REGISTERED.

Kilowatt Publishing Co., Ltd. (90,715).—This company was registered on November 7th, with a capital of £10,000 in £10 shares, to carry on the business of newspaper proprietors and publishers, printers, typefounders, booksellers, stationers, advertising agents, &c. The first subscribers are:—F. C. Raphael, "Fors," Hayes Road, Bromley, Kent, electrical engineer,

124 shares; F. S. Warburg, 8, Porchester Terrace, W., gentleman, 100 shares; O. E. Warburg, 2, Craven Hill, W., gentleman, 100 shares; L. E. Raphael, 4, Connaught Place, W., barrister, 100 shares; S. R. Rogers, 10, Falkland House, Cheniston Gardens, Kensington, W., electrical engineer, 100 shares; C. Clay, 7, Bread Street Hill, E.C., master printer, 175 shares; and A. Webster, 28, Effingham Road, Hornsey, N., clerk, 1 share. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification (except managing director), 20 shares; remuneration of chairman, £100; of other directors, £50 each per annum. Registered office, 203-6, Temple Chambers, E.C.

W. D. Palmer & Co. Ltd. (6,336).—This company was registered in Edinburgh on November 8th, with a capital of £5,000 in £1 shares, to carry on the business of electrical engineers and contractors, manufacturers of plant, tools, and laundry and other machinery, &c., in Glasgow or elsewhere in the United Kingdom. The first subscribers (each with one share) are:—W. D. Palmer, 50, Wellington Street, Glasgow, engineer; M. Howat, 50, Wellington Street, Glasgow, clerk; H. Macmillan, 163, Hope Street, Glasgow, chartered accountant; A. Ker, 152, St. Vincent Street, Glasgow, chartered accountant; J. Macmillan, 226, West George Street, Glasgow, solicitor; W. Ritchie, 4, Wendover Crescent, Mt. Floride, clerk; and Miss C. Palmer, 1, Central Avenue, Partick, Glasgow. The number of directors is not to be less than two nor more than five; the first are W. D. Palmer and A. J. Macarthur; qualification, 100 shares; remuneration of managing director, £600 per annum; of other directors, as fixed by the company. Registered office, 50, Wellington Street, Glasgow.

CITY NOTES.

Eastern Extension, Australasia and China Telegraph Co.

The sixty-sixth half-yearly ordinary general meeting of this company was held on Wednesday at Electra House, E.C., Sir John Wolfe Barry presiding.

The Chairman, in moving the adoption of the report, said that the half-year under review did not compare favourably with the corresponding half-year of 1905, owing to the termination of the Russo-Japanese war. The revenue amounted to £303,000, as against £348,000 for the corresponding period last year, a decrease of £45,000. The figures were somewhat misleading, as the receipts for 1905 included several amounts which could not be put in the 1904 accounts, although they belonged to that year. As a matter of fact, the decrease in the revenue was only about £20,000. Their traffic to and from Australia had been going on steadily. Wars caused a spasmodic increase in their revenue, but he really thought it was better for the company when peace prevailed. Turning to the working expenses, they were £144,000, as compared with £136,000. Expenses of maintenance had increased by £1,200, and renewals were £700 more. The sum of £435 for legal expenses was incurred in litigation with the New Zealand Government over what income-tax the company should pay and what the tax should be assessed on. The New Zealand authorities considered that they should assess the tax on the traffic between Australia and India, but the company contended that they should only pay a tax on traffic between New Zealand and Australia. The Court first decided in favour of the Government, but on appealing to the Supreme Court the decision was reversed; the Government further appealed to the Privy Council, who upheld the decision of the Supreme Court and unanimously decided in favour of the company. They had also come to an arrangement with the income-tax authorities over here, and that question would not trouble them for the next 10 years. The net profit for the year was £142,894 as against £163,958.

The Marquis of Tweeddale seconded the motion, and the report was adopted.

United River Plate Telephone Co., Ltd.

This company held a meeting at Winchester House on Tuesday, Mr. J. Irving Courtenay presiding, to consider a proposal (which had been explained by circular) enabling the directors to create and issue debenture stock at such times and in such manner as they thought expedient up to one-half of the issued capital. It is felt that the position and prospects of the company are now such that it should be able to borrow on debenture stock at less than 5 per cent.—the rate at present being paid. Before the resolution could be carried into effect the outstanding debenture stock would have to be paid off at 110, for which purpose six months' notice would have to be given. It is not considered that the present is a suitable time for making the change, but the directors wish to be in a position to take advantage of a favourable opportunity.

The Chairman, in moving the necessary resolution, said that the company now had a paid-up share capital of £700,000, while it had only £164,000 of debenture stock outstanding, which amount, under the present powers, could not be materially increased. During his recent visit to Argentina he found that progress was being made throughout the whole Republic, and the consequence of this continued prosperity, especially in the provinces of Buenos Ayres and Santa Fe, was that their business had largely developed and expanded, not only in their principal place of business, Buenos Ayres, but also in the smaller towns which made up their provincial section. They had completed the new trunk line to Rosario (some 250 miles), and hoped to open it for public service very shortly. Their underground plant in Buenos Ayres and Rosario was making excellent progress. This all meant capital expenditure, but in their view it was capital well expended. The increased profits for the past two years had more than met the charges necessitated by the new capital, and he could safely predict that the new charges in the present year would be as easily met as in the past.

Mr. Frederick Green seconded the resolution, and a brief discussion ensued, in the course of which a shareholder asked at what rate of interest the new debentures would be issued and what amount would be required, say, within the next two years. The Chairman said that he could not say at the moment. They had to give six months' notice, and he hoped that nobody expected that next June or July money would be the same price as to-day. They wanted to take advantage of a favourable opportunity. Their borrowing powers were practically exhausted. The total amount unissued was only £10,000, and that was utterly inadequate for the requirements of such a company. Although the balance-sheet showed only about £164,000 of debenture stock outstanding, £190,000 had actually been issued, but the balance of £26,000 had been cancelled, because by a recent judgment such could not be re-issued, therefore for legal reasons they had to come to the shareholders, for there were practically no borrowing powers left worth mentioning. They hoped to borrow at lower rates than at present, and as to the amount they would be guided by the price they could get. If not worth their while to borrow more money, they would issue share capital, being entirely guided by the circumstances. The amount they would require would depend upon the demands of the business. It might be profitable to issue debentures, or they might prefer to issue shares or to make a judicious blend and issue both.

Another Shareholder (Mr. Anderson) argued in favour of retaining the debentures and issuing ordinary shares, giving the shareholders the advantage to be gained. Such a course would not increase the fixed charges, but if it did keep the dividend down they would not be so likely to invite competition from others. He advocated a second debenture at 4 per cent. interest.

Mr. Ritchie having supported Mr. Anderson's views, Mr. J. E. Kingsbury appealed to his fellow-shareholders not to hamper the directors in any way in the powers that were sought by them.

The Chairman, in reply, said that they were paying 5 per cent. for their first mortgage debenture. Would anybody be likely to take a large amount of second mortgage at 4 per cent.? They proposed to do the very best they could for the company, but they could not bind themselves, because they could not possibly tell what the state of circumstances might be at the time they would have to go into the operations.

West India and Panama Telegraph Co., Ltd.

The directors' report for the six months ended June 30th, 1906, states that the amount to credit of revenue is £36,999, against £32,774, for the corresponding half-year of 1905. The expenses have been £25,681, against £23,230, leaving a balance of £11,319, to which is added £1,772 interest on investments, and £1,047 brought forward from last account, making a total of £14,138. It is proposed to pay 8s. per share on the first preference shares (being 4s. balance of arrears to December 31st, 1905, and 4s. on account of dividend June 30th, 1906) £13,825, carrying forward £313. The traffic receipts for the six months show an increase of £4,325, as compared with those for the corresponding period. The expenses of repairing cables, charged to revenue, amount to £9,958, as compared with £8,363 for the corresponding half-year. There has also been a special expenditure of £7,650 for the charter of the ss. *Cambria*, and £10,621 for the cable used by her in restoring and partially renewing some of the interrupted cables referred to in the last report. Both these amounts have been charged to reserve. The directors are of opinion that this expenditure has resulted in strengthening the whole system. The question of increasing the reserve fund, which now stands at £93,596, has been under the consideration of the directors; but, in view of the state of the revenue, they do not propose to make any addition to that fund at present.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Anglo-Argentine Tramways Co., Ltd.—37,000 ordinary shares of £5 each, fully paid, Nos. 510,008 to 547,007; and 13,000 ordinary shares of £5 each, fully paid, Nos. 547,008 to 560,007.

Perth Electric Tramways, Ltd.—100,000 ordinary shares of £1 each, fully paid. (Special application.)

Rangoon Electric Tramway and Supply Co., Ltd.—£150,000 4½ per cent. first mortgage debenture stock; and 30,000 6 per cent. cumulative preference shares of £5 each.

The Committee have appointed special settling days as under:—

Thursday, November 22nd.—Mexican Electric Light Co., Ltd.—$6,000,000 5 per cent. first mortgage gold bonds, Nos. C 1 to C 1,000 for $100 each, D 1 to D 3,000 for $500 each, and M 1 to M 4,400 of $1,000 each.

Mexican Light and Power Co., Ltd.—$13,650,000 capital stock in shares of $100 each, and $12,000,000 5 per cent. first mortgage gold bonds, Nos. 1 to 4,000 for $500, and 4,001 to 14,000 of $1,000 each.

St. James' and Pall Mall Electric Light Co., Ltd.—During the quarter ended September is returned at 1,395,563 units, estimated to produce £16,984, as against 1,375,210 units, which produced £18,083 for the corresponding period of 1905.

Amazon Telegraph Co., Ltd.—A financial paper says that the accounts for the year to June 30th last, after providing for the service of the debentures, show a surplus of £3,628, thus reducing the debit balance brought down to £74,607.

MARKET QUOTATIONS.

Wednesday, November 14th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£18	..
a	Borax	per ton	£15	..
a	Benzole (90 %)	per gal.	10½d.	..
a	,, (50 %)	per gal.	1/-	..
a	Copper Sulphate	per ton	£31 10	..
a	Lead, Nitrate	per ton	£31	..
a	,, White Sugar	per ton	£35	..
a	,, Peroxide	per ton	£32	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	9½d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£30	..
a	Potassium Cyanide	per lb.	8½d.	..
a	Shellac	per cwt.	220/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 % ..	per ton	£10 15	..
a	,, Crystals	per ton	£3 5	..
a	Sodium Bichromate, casks ..	per lb.	2¾d.	..
a	,, Cyanide	per lb.	7½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£200	..
b	,, Wire, in ton lots ..	per ton	£220	..
b	,, Sheet, in ton lots ..	per ton	£210	..
b	Babbitt's metal ingots	per ton	£43 to £140	..
c	Brass (rolled metal 2' to 12') basis	per lb.	10½d.	..
c	,, Tube (brazed)	per lb.	1/-	¼d. inc.
c	,, ,, (solid drawn) ..	per lb.	11½d.	¼d. inc.
c	,, Wire, basis	per lb.	10½d.	..
c	Copper Tubes (brazed)	per lb.	1/2	¼d. inc.
c	,, ,, (solid drawn) ..	per lb.	1/2½	¼d. inc.
g	Copper Bars (best selected) ..	per ton	£115	£1 inc.
g	Copper Sheet	per ton	£115	£1 inc.
g	,, Rod	per ton	£115	£1 inc.
e	,, (Electrolytic) Bars ..	per ton	£104 10	30/- inc.
e	,, ,, Sheets ..	per ton	£116 10	30/- inc.
e	,, ,, Rod ..	per ton	£107	£2 inc.
e	,, ,, H.C. Wire ..	per lb.	1/0¾	¼d. inc.
f	Ebonite Rod	per lb.	3/3	..
f	,, Sheet	per lb.	3/-	..
m	German Silver Wire	per lb.	1/8	..
h	Gutta-percha, fine	per lb.	6/- to 7/-	..
h	India-rubber, Para fine	per lb.	5/- to 5/1½	dec.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	56/9	1/1½ dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£19 15 to £19 17 6	2/6 inc.
g	,, ,, Sheet	per ton	£21 15 to £21 17 6	2/6 inc.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/3½ to 1/6	..
p	,, rolled bars & rods	per lb.	1/4½ to 1/5½	..
p	,, ,, strip & sheet	per lb.	1/5 to 1/8	..
o	Platinum	per oz.	nominal	..
e	Silicium Bronze Wire	per b.	1/- to 1/1	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block (English)	per ton	£196 to £197	£4 inc.
n	,, Wire, Nos. 1 to 16	per lb.	2/4	..
p	White Anti-friction Metals—			
	"White Ant" brand	per ton	£46 to £70	..
k	Zinc, Sh's (Vieille Montagne bnd.)	per ton	£32 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Ferranti, Ltd.—An extraordinary general meeting is to be held at Winchester House on Friday next, 23rd inst., to confirm a resolution altering the articles of association.

West India and Panama Telegraph Co., Ltd.—A dividend of 8s. per share on the first preference shares (being 4s. balance of arrears to December 31st, 1905, and 4s. on account of dividend to June 30th, 1906) has been recommended.

Provincial Tramways Co., Ltd.—For the past year the directors recommend a final dividend of 4s. 6d. per share on the ordinary shares, making 7s. 6d. per share for the year. £9,000 has been set aside for depreciation in respect of the company's various undertakings.

STOCKS AND SHARES.

Tuesday Afternoon.

Money conditions are little easier than they were a week ago, and the fears of a rise in the Bank Rate are still with us. Investment markets stand up with a very fair amount of strength against the pressure of stiff money. Home Railway stocks continue dullish; there is no interest being taken in them, and the progress of the Trades Disputes Bill tends to counteract whatever favourable impression might otherwise have been caused by the splendid Board of Trade returns.

Electrical railway stocks, though not likely to be much affected by politics, sympathise with the tone of the steam railway market. Prices do not give way to any extent; they are just dull. As an instance of this, it may be mentioned that a seller wanted the other day to realise a few hundred pounds of the Great Northern and City 4 per cent. Debenture stock. Nominally, the price is supposed to be in the neighbourhood of par, but actually, he could not obtain a bid at all.

Districts slipped back a little to 20¼, and Metropolitan Consolidated is better at 6. Some few electric trains have commenced running on the Metropolitan between Hammersmith and the East. The Great Northern, Piccadilly and Brompton line is rapidly approaching completion, and may be open by Christmas.

Tube stocks show no alteration on the week. The unusual largeness of the crowds to see the Lord Mayor's Show last week does not seem to have assisted the railways much. This week's traffics should be helped by the sightseers who come to town in order to catch a fleeting glimpse of the King and Queen of Norway and their little chap. The feature of the week in our markets is the brisk recovery in British Electric Traction shares, rendered all the more noticeable by the decline in the prices of the two Debenture stocks. The Ordinary shares rose from 3⅞ to 4⅛, the Preference from 7⅞ to 8¼. We are told, unofficially, that a small syndicate has the late Mr. George Herring's stocks and shares in hand, and that there is no intention to disturb the market in any way. Moreover, a semi-official view lately set forth the likelihood of the next dividend on the Preference shares being met, and so a judicious measure of support proved adequate in rallying the prices of the shares. But the First Debenture stock is a point lower, and the Seconds have fallen 2. Brush Second Debenture is also 1 per cent. easier. London United Tramways remain without change.

In the Electrical Supply list, Edmundson's Ordinary are down ¼, which brings the price to 3. The few sellers have much difficulty in getting a bid, and the possibility of the next dividend being passed is freely discussed. Charing Cross City Preference shares have been lowered to 4, and London Electric Preference to their par value of £5. On the other hand, St. James' Ordinary added a further 5s., making them 10¼. Metropolitan Electrics were unaffected by the withdrawal of opposition to their Bill. The one change in the prior-charge list is a fall of a point in Edmundson's Debenture stock

With the duller tone in supply shares, Electric Construction Preference gave way ¼. Castner-Kellner Alkali rose ⅛ upon the increased dividend, to which reference was made last week. There has been a small inquiry for Callender's Debenture stock. British Aluminium Preference at 5½ are the turn lower.

After their rise of two points in the previous week, Anglo-American Deferred fell back a shade, only to be taken in hand yet more vigorously, the price bounding up to nearly 27½. The dividend prospects are held to be justification for this remarkable revival, which has scarcely touched the senior stocks of the company. Anglo Ordinary put on ½, but the Preferred fell a like fraction. Manipulation is largely responsible for the boomlet in the "A" stock. Sharp advances are also to be noted in the West India and Panama group, all the issues being benefited.

Direct United States shares have receded, notwithstanding the jump in Anglo-Americans. Amazon Telegraphs are also lower, having fallen 10s. to 3¼. The Eastern division weakened generally. "China" shares at 13½ are ¼ lower, and Eastern Ordinary dropped 2 to 139½. Both are now on a basis that pays 5 per cent. to an investor at present prices. Great Northern Telegraphs shed part of their earlier improvement, and Globe Ordinary and Preference have slightly weakened. Money conditions, of course, are much against investment in this department.

For the second consecutive week, there is no movement in Telephone issues. Marconi's Wireless Telegraph shares are not quite so good. Tramway securities have scarcely changed. Calcutta Ordinary at 8 are ¼ down. All the shares, old and new, have come into line, and no difference exists between the two classes.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1903.	1903.	1904.	1905.	Closing Quotations Nov. 6th.	Closing Quotations Nov. 13th.	Business done week ended Nov. 13th, 1906. Highest.	Lowest.	Rise + or Fall −
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	8⅜ — 4½	8¼ — 8½	70/-	..	— ½
155,500	Do. do. 5 % Debs., Nos. 1 to 1,200 Red.	100	Nil	Nil	Nil	5 %	88 — 93	84 — 93	..	..	..
709,500	Anglo-American Telegraph	Stock	60/6	61s.	2¾%	3½%	65½ — 67½	66 — 68	66½	65	+ ½
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¼%	6 %	109½—110½	109 —110	109½	107½	— ½
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	¼%	25½— 26½	27½— 27⅞	27	25½	+1⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..
1,992,855	Commercial Cable Stlng. 500 year 4 % Deb. Str. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	98½	97½	..
16,000	Cuba Telegraph	10	6¾%	10 %	5 %	5 %	8½— 9 xd	8½— 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18 xd	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅞— 3⅞	3⅞— 3⅞	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅞— 9⅜	8⅞— 9⅜	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½—102½	99½—102½	..	..	..
60,710	Direct United States Cable	20	8½%	8 %	5½%	4½%	15⅝— 16	15⅝— 15⅞	15⅞	15½	— ⅛
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	140 —143	138 —141	142	139	—1½
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	70 — 72	91½	..	..
1,848,773	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	107½	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13½ — 14	13½ — 13⅝	13⅝	13⅜	— ¼
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	106½—107½	105½—107½	106¼	105¼	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101 xd	99 —101 xd	..	..	..
180,887	Globe Telegraph and Trust	10	£8	5½%	5⅝%	5½%	10½— 10⅝xd	10⅝— 10⅝	10⅞	10⅝	— ⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅛— 14⅜xd	14⅜— 14⅝	14⅝	14⅜	— ⅛
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	36 — 38	35½— 37½	36½	..	— ½
97,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	58½— 60½ xd	58½— 60½	60	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 — 1⅛	1 — 1⅛	21/3	20/-	—1/16
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	5 %	1 1/16xd — 1 3/16xd	1 — 1⅛	..	..	—1/16
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	1 xd	1 ..	..	..	..
1,988,888	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108 —110	109½	108½	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108 —110	108 —110	108⅝	108½	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	11½	11½	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½— 12½	10½— 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P.. 1 to 250,000	5	5 %	5 %	5 %	5 %	6⅛— 6⅝	7⅛— 6⅝	..	..	..
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98 —100	98 —100	98	..	..
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102	101	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¾%	6¾%	7½%	1½ — 1⅝ xd	1½—1⅝	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8 xd	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7¼— 7⅜	7¼— 7⅜	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
8,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	127½	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7½	7 — 7½	7 1/16	7½	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼— 5½	5¼— 5½	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —113	110 —113	..	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	10 — 10½	10 — 10½	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 88,001 to 88,008	2½	Nil	Nil	Nil	Nil	2/16 — 3/16	2/16 — 3/16	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½—102½	100½—103½	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	7 %	14⅛ — 14⅝	14⅛ — 14⅝	14 1/16	14⅛	..
568,880	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	102½	102	..
88,821	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	10/-	..	+1/16
34,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	7¼— 8	7¼— 8¼	8½	8	+ ¼
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4½— 5½	5 — 6	..	..	+ ½
60,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	100—103	..	..	+1

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	..	8 %	8 %	7 — 7⅛	7 — 7⅛	7 3/16	7 1/16	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5 3/16 — 6 1/16	5 3/16 — 6 1/16	5 3/16	5 2/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	139 —142	139 —142	141⅜	..	..
235,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	103 —105	103 —105	105	..	..
800,000	Babcock & Wilcox, 1 to 800,000	1	..	17 %	20 %	20 %	3⅜ — 4	3⅞— 4⅛	79/4½	77/9	+ ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..
98,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	5 1/16— 5 1/8	5⅛— 5⅛	5⅛	..	— 1/16
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6¼— 6⅜ xd	6¼— 6⅜	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼— 5⅜	5¼— 5⅜	..	..	..
80,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4⅛	4 — 4⅛	..	..	..
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	102 —106 xd	102 —106	102½	101½	..
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	..	100 —103	100 —103	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	125 —130	125 —130	..	..	..
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —115	110 —115	113½	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
280,000	Do. 4½ % Vancouver Power Debs., 1 to 2,900	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
188,301	British Electric Traction	10	3 %	6 %	6 %	3 %	3½— 4	3⅞— 4⅛	85/-	75/-	+ ⅛
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	7⅜ — 8	8 — 8⅜	8 3/16	7⅞	+ ⅛
1,415,429	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	105 —109 xd	104 —107	107	104	—1½
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	87 — 90 xd	85 — 88 xd	87	86½	—2
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6½— 6⅝	6 — 6½	6⅝	..	— ½
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛	5⅝— 6⅛	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	94 — 98	94 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1 — 1⅛	1 — 1⅛	27/6	23/9	..
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	75 — 79	75 — 79	77½	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	½— 1	½— 1	16/3	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	26/3	..	..
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	88 — 86	82 — 85	..	..	—1
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3 — 3⅛	3 — 3⅛	..	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅛— 5⅜	4⅛— 5⅜	..	..	..
317,700	Do 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8 — 8⅛	7⅞— 8⅛	8 3/16	8	— ⅛
82,610	Do. 105,001 to 187,610	5	..	..	..	8 %	7⅞— 8⅛	7⅞— 8⅛	..	..	— ⅛
29,380	Do. 5 % Cum. Pref., Nos. 1 to 29,330	..	..	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5 3/16	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	105	..	..
95,000	Callender's Cable Construction shares ..	5	15 %	12½%	12½%	15%	10 — 11 xd	10 — 11	10½	10	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108½—110½	..	..	+1
491,232	Cape E. Trams., 1 to 491,232	1	..	15 %	10 %	5 %§	3/16 — 5/16	3/16 — 5/16	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/16 — 1 1/8	1 3/16 — 1 1/8	23/9	22/9	+ 1/16
280,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,989,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	83⅝	..	..
580,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
580,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	..	..	..
1,460,000	City and South London Railway	Stock	3½%	2¾%	3⅜%	12½%	41 — 43	41 — 43	42½	41⅜	..
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	2½%	2½%	2½%	1½ — 1⅝	1½ — 1⅝	30/-	..	..
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(Continued)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(continued).

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Nov. 6th.	Closing Quotations Nov. 13th.	Business done week ended Nov. 13th, 1906. Highest	Lowest.	Rise or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	£1	..	..	10 %	10 %	1 7/16 — 1 1/8	1 7/16 — 1 1/8	23/6	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	£1	..	6 %	6 %	6 %	1 1/8 — 1 1/4	..	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	£10	..	5½ %	6 %	6 %	14 — 15	14 — 15	15	..	..
59,987	Do. 6% Pref. between 1 and 60,000	£10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	£5	Nil	Nil	2½ %	4⅓ %	1¼ — 1⅜	1¼ — 1⅜	..	..	..
17,189	Do. "A" shares, 01—017,189	£5	Nil	Nil	2½ %	4⅓ %	2⅛ — 2¼	2⅛ — 2¼	..	..	..
844,028‡	Do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	£100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	£2	6 %	4 %	Nil	Nil	7/16 — 7/16	7/16 — 1/16	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	£2	7 %	7 %	7 %	7 %	1⅛ — 2¼	1⅛ — 2	33/1½	..	— ½
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	£10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	91 — 94	91 — 94	92	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	£10	..	3 %	4 %	4 %	3¼ — 3⅜	3¼ — 3⅜	67/6	66/3	..
96,000	Greenwood & Batley 7 % Cum. Pref.	£10	..	7 %	7 %	7 %	10½ — 10⅝	10½ — 10⅝	..	..	..
80,000	Do. do. 5 % Mort. Debs.	£100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	£5	20 %	15 %	15 %	15%	12 — 13	12 — 13	12½	..	..
200,000	Do. do. 4½ % Pref.	£5	4½ %	4½ %	4½ %	4½ %	5¼ — 5½	5⅛ — 5⅜	5⅜	5¼	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	108 —110	108 —110	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	£10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅜	..	..
87,500	†Liverpool Overhead Railway, Ord.	£10	14%	18%	12½	Nil	1½ — 1⅝	1½ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	£10	5 %	5 %	5 %	5 %	4½ — 6½	5 — 6	..	..	+ ½
600,070	London United Trams (1901), 1 to 50,007	£10	..	8 %	6 %	8 %	8 — 8⅝	7 — 9	..	..	— ½
899,930	Do. do. 60,008 to 100,000 (£6 paid)	£10	..	8 %	6 %	8 %	3½ — 4½	3½ — 4½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	£10	..	5 %	5 %	5 %	8 — 9	8 — 9	8½	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	90 — 95	90 — 95	..	..	..
314,016	Metropolitan Electric Trams, Defd.	£1	Nil	Nil	Nil	3 %	1/16 — 3/16	1/16 — 3/16	..	..	..
500,000	Do. 5 % Cum. Pref.	£1	5 %	5 %	5 %	5 %	13/16 — 15/16	13/16 — 15/16	17/6	..	..
850,000	Do. 4½ % Deb. Stock Red.	£100	..	..	4½ %	4½ %	97 —100	97 —100	99½	98½	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	£5	..	..	6 %	6 %	4⅞ — 5	4⅞ — 5	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	£10	..	5 %	5 %	4 %	6¼ — 7¼	6¼ — 7¼	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	£10	..	5 %	5 %	5 %	7¼ — 8¼	7¼ — 8¼	..	..	..
245,000	Do. 4½ % Deb. Stock	£100	..	4½ %	4½ %	4½ %	101 —104	101 —104	..	..	..
87,850	Telegraph Construction and Maintenance	£12	20 %	20 %	15 %	15 %	82 — 84	82 — 84	..	..	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	£100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	£100	3½%	3½%	3½%	3½%	99 —102	99 —102	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£5	8½%	8 %	Nil	Nil	¼ — 1	¼ — 1	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	£5	..	6 %	Nil	Nil	1½ — 2¼	1½ — 2¼	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£5	..	5 %	5½%	4 %§	5 — 5½	5 — 5½	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	£100	..	4½ %	4½ %	4½ %	99 —101 xd	99 —101	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£5	8 %	10 %	10 %	10 %	8½ — 8⅝	8½ — 8⅝	..	..	..
10,623	Do. do. 7 % Cum. Pref.	£5	7 %	7 %	7 %	7 %	7⅞ — 8	7⅞ — 8	7⅞	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	£100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	£5	10 %	8 %	8 %	5 %	3½ — 4½	3½ — 4½	84/4½	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	£5	4½ %	4½ %	4½ %	4½ %	4½ — 5	4½ — 5	95/-	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	£5	4½ %	4½ %	4½ %	4½ %	4 — 4½	3⅜ — 4½	..	..	— ½
420,000	Do. do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
44,486	Chelsea Electricity Supply, Ord.	£5	4½ %	5½ %	6 %	6 %	5½ — 5⅝	5½ — 5⅝	..	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	108 —109	106 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	£10	5 %	5 %	6 %	6 %	9½ — 10½	9½ — 10½	10⅝	..	..
40,000	Do. 5 % Cum. Pref., 1 to 40,000	£10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	11⅛	..	..
400,000‡	Do. 5% Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
500,000	Do. 4½ % 2nd Db. Stk., Prov. Cris., all pd.	£100	4½ %	4½ %	4½ %	4½ %	100 —103	100 —103	102	..	..
40,000	County of Durham Electrical Power, Ord.	£2	4 %	4 %	£3 7 0	4 %	2⅛ — 3⅛	2⅛ — 3⅛	..	..	..
80,000	Do. do. 5 % Pref.	£5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4½ %	5 %	8½ — 8⅝	8½ — 8⅝	..	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	£10	6 %	6 %	6 %	6 %	11¼ — 11⅜	11¼ — 11⅜	..	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½ %	4½ %	4½ %	4½ %	107 —110	107 —110	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	100 —102 xd	100 —102	100⅜	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	7 %	4 %	3 — 3½	2⅜ — 3½	58/9	..	— ½
80,000	Do. do. 6 % Cum. Pref.	£5	6 %	6 %	6 %	6 %	4⅜ — 5½ xd	4⅜ — 5½	98/9	..	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	£100	4½ %	4½ %	4½ %	4½ %	100 —103	99 —102	100½	..	—1
10,000	Folkestone, 1 to 10,000	£5	..	5½%	5½%	5½%	5½ — 5⅝	5½ — 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£5	..	..	..	5 %	4⅝ — 5⅝	4⅝ — 5⅝	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	£100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	£5	..	8½%	8½%	9 %	8 — 8½	8 — 8½	..	..	..
10,000	Do. New (£6 10s. paid)	£8	..	8½%	8½%	9 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..
97,300	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	99 —101	96 — 99 xd	..	..	..
7,300	Do. 4½ % Deb. Stock	£100	..	4½ %	4½ %	4½ %	99 —101	96 — 99 xd	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	12 %	12 %	10 %	9⅞ — 10⅛	9⅞ — 10⅛	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —101	..	..	—1
111,000	London Electric Supply Corporation, Limited, Ord.	£3	Nil	Nil	3 %	4 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..
60,000	Do. do. do. 6 % Pref.	£5	6 %	6 %	6 %	6 %	4⅝ — 5⅝	4⅝ — 5⅞	5 1/16	97/6	+ ⅛
674,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	£5	7½ %	8%	10 %	10 %	7⅜ — 8⅜	7⅜ — 8⅜	8⅛	8 3/16	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£5	4½ %	4½ %	4½ %	4½ %	5⅝ — 5⅞	5⅝ — 5⅞	5⅞	5 13/16	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½ %	4½ %	4½ %	4½ %	109 —113	109 —113	110	..	..
250,000‡	Do. 5% Mort. Deben. Stock Redeem.	Stock	5½%	5½%	5½%	5½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	£100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	£5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	£5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	£10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	£100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£5	..	6½%	7 %	7 %	6⅛ — 6⅝	6⅛ — 6⅝	..	..	..
80,000	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	12½%	9½ — 10⅛	9⅝ — 10⅛	10⅛	10⅛	+
20,000	Do. do. 7 % Pref. 20,081 to 40,080	£5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7⅞	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	£100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	2½%	4 %	4 %	4 %	1 — 2	1 — 2	..	..	..
80,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..
65,000	South London Electricity Supply, Ord.	£5	12½	3 %	4 %	4 %	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..
121,000	South Met. Elec. Lt. & Power, Ord.	£1	1	Nil	Nil	2½%	1/16 — 1/8	1/16 — 1/8	..	..	..
117,968	Do. Do. 7 % Pref.	£1	Nil	7 %	7 %	7 %	1 15/16 — 1 15/16	1 15/16 — 1 15/16	26/10½	..	..
200,000	Do. Do. 4½ % 1st Deb. Stk.	£100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
50,000	Urban Electric Supply, Ord.	£5	5 %	5 %	5 %	5 %	3 — 3½	3 — 3½	..	..	..
80,000	Do. do. 5 % Cum. Pref.	£5	5 %	5 %	5 %	5 %	4½ — 4⅝	4⅜ — 4⅝	91/3	90/-	..
00,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	£100	..	..	4½%	4½%	97 —100	97 —100	..	..	..
110,000	Westminster Electric Supply, Ord.	£5	12 %	12½%	14 %	12 %	9½ — 10½	9½ — 10½	9⅝	9⅜	..
23,151	Do do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1906.	£5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	5⅝	5½	..

Shares not officially quoted:—Mackay Companies, ord., 73—75. Pref. 72—74.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 6 per cent. October 18th, 1906.

THE WIRELESS TELEGRAPH CONFERENCE.

[COMMUNICATED.]

Although the text of the decisions of the International Conference, which has just concluded its labours at Berlin, has not yet been made public, it is satisfactory to learn that agreement has been arrived at upon all the substantial issues, and this without imperilling the special interests of the naval and military services of the nation. So much that is irrelevant and misleading has been permitted to appear in the public Press, that it is the more important that readers who belong to the electrical profession should have a clear understanding of the scope of the Conference and the matters involved in its decisions.

There are recognised by the Admiralty four different kinds of wireless work: (1) Signalling for tactical purposes to and from the ships of a squadron; (2) "long-distance signalling" over 500 miles or more, as from the wireless telegraph station at Poldhu, or the Telefunken stations at Nauen and at Vladivostock; (3) ship-to-shore signalling, or "maritime signalling," as the Admiralty call it; (4) "sea telegraphy," meaning thereby the receipt and transmission of messages to and from passengers on vessels. To these may be added two other kinds: (5) tactical signalling, as practised by the army overland; and (6) ship-to-ship signalling between vessels passing one another at sea. These different applications have different aims; and it is certain that different forms of apparatus, possibly that totally different inventions, will be found best adapted to different cases. For example, it has been found—and the failures of the Marconi apparatus in Somaliland and elsewhere prove it—that for overland work, where the soil is of variable conductivity, no apparatus is satisfactory in which an earth-connection is used. On the other hand, a portable apparatus which will give perfectly good and certain signals over 20 or 30 miles overland may be totally unadapted for use on ship-board or at a coast station to signal to ships 100 miles out at sea.

As for the secrecy which has so often been alleged to characterise one or other "system" of wireless telegraphy, every one who has worked at the subject knows that there is no such thing in itself. Any and every system that has yet been devised pours out ethereal waves into space around the transmitter. Whether the transmitter is tuned or untuned, any appropriate receiver within range will pick up some of the waves. The use of code alphabets is the only kind of secrecy yet possible.

Interference between stations is a question for which tuning has hitherto been a partial remedy. Whether the more perfect tuning said to be attained by the new Poulsen system will eliminate the trouble remains to be seen.

Beyond these physical questions lie others of a different nature. The navies of the great Powers have been keen to develop systems that shall be best for their own ends, and each is under the belief that its own system is the best. The British Admiralty which began with the Marconi system is gradually developing its own. It is still under agreement with the Marconi Co. in certain respects; but it is not compelled to purchase any more apparatus from that company except jiggers and trays of Leyden jars; indeed, the company in its contract with the Admiralty has expressly renounced any claim for royalty or damages for infringement in respect of any wireless telegraph apparatus (other than jiggers and jars) manufactured for the Admiralty by other parties. The Admiralty has agreed not to use such Marconi apparatus as it already possesses (save in emergency, or war or distress signals) in interchanging signals with vessels not equipped with Marconi apparatus; or if it does, it must compensate the Marconi Co., under arbitration. Save for this reservation the Admiralty has now practically a free hand in wireless work. The United States Navy uses a different system—the Telefunken—and also has some stations equipped with American apparatus. The Japanese navy has its own system, so has the French navy. So, also, have the German and Austrian navies. The Italian navy is said to use the Marconi system exclusively: the reasons are laudably patriotic.

Very different is the position of Lloyds, which is tied hand and foot, until the year 1913, to use no other apparatus than that of the Marconi Co., no matter what new and improved apparatus may be invented.

Turning to the commercial developments of wireless work, one becomes aware that things are not exactly as the Dick Swivellers of journalism (to adopt Mr. Bernard Shaw's elegant phrase) have represented them to be. In the first place, by far the largest number of wireless stations over the world, including those on shipboard, have been erected by the Telefunken Co. which has now no fewer than 628. Of these 150 are in Russia, 13 in Norway, 11 in the Argentine, 11 in Brazil, 24 in Sweden, 29 in Austria, 2 in Portugal, 14 in Spain, 2 in the Philippines, 5 in the Dutch Indies, 2 in Siam, 2 in Tonking, 2 in Peru, &c. The Marconi Co. comes next; it is said to have nearly 400 stations, and, thanks to its agreement with Lloyds, it has secured those on the south coast of England, and on most of the Atlantic liners. The De Forest Co. follows on, but it has not more than 50 stations outside the United States. The Lodge-Muirhead Syndicate has a smaller number, some of them in the East. As for the other American systems, those of Stonemaker, Fessenden and Stone, there are no reliable statistics. The Ducretet and Rochefort systems appear to be confined to France and Spain.

This being the state of the art, it is not surprising that in the interests of the merchant service of all nations—and the merchant service of Great Britain far outweighs all others—it has been found desirable to establish some general understanding; so that all merchant and passenger ships, on passing a station or approaching a port, might report themselves, irrespective of the particular "system" installed on the ship or at the coast station. To achieve such an international understanding has been the chief, one might almost say the sole, aim of the Conference at Berlin.

At that Conference the nations were represented solely by official delegates. No inventors were invited or sent. The three great departments—the Admiralty, the Army and the Post Office—were represented. Their delegates went out with a perfectly definite policy. The Colonial Office was consulted by the Post Office, and concurred in the British policy.

The net results, so far as known, show that in the first place the understanding arrived at does not in any way touch the interests of tactical signalling; naval and military operations stand absolutely outside the scope of the Conference. In the next place, the British delegates opposed a proposal, sprung upon the Conference by the American representatives, to make ship-to-ship communication compulsory. Some of the other nations have agreed amongst themselves to this; but Great Britain rejected the proposal, which was not set down in the protocol of the Conference, deeming it to be impracticable. What the Conference has agreed to—Italy dissenting, it is understood, because of its agreements that tie it to the Marconi Co.—is that the contracting States undertake to make arrangements for wireless telegraphy between their coast stations and vessels of all nationalities, whatever system these vessels employ. There are reservations as to particular sites of stations to be thus treated as open stations of call for maritime signalling. There is also to be established an international bureau, on the lines of the International Postal and Telegraph Bureau at Berne, to keep the registers of the stations and of the ships, and generally to facilitate the administration of the system.

From this sensible and useful result England, having the largest number of merchant ships, will be the greatest gainer. She has sacrificed no prestige. She has given away no monopoly, for the very simple reason that she has no monopoly to give away. The commanding position which the writer of the leading articles in the *Times* assumes Great Britain to have held in wireless work, is as purely a matter of fancy as is the declaration that the Marconi Co. at present "enjoys" a practical commercial monopoly of wireless telegraphy. The obvious fact is that the Marconi Co. has been outstripped by its rivals. While it has been wasting its efforts—it is two years since that notorious message from President Roosevelt to King Edward, to which His Majesty replied by cable—in trying to establish a trans-Atlantic service between Poldhu and Cape Cod, and making sensational "demonstrations" with no other apparent result than to frighten the shareholders of the cable companies, the Telefunken Co. and the De Forest Co. have covered the globe with a multitude of stations.

The dog-in-the-manger policy of the Marconi Co. in refusing to take messages from ships equipped with other systems has brought about a strange revenge. German vessels sailing from Hamburg to Buenos Ayres report themselves to Cuxhaven, to Heligoland, to Borkum, to Scheveningen and to Ushant, leaving the Marconi stations severely alone.

The satisfaction that an international understanding should have been arrived at with practical unanimity, is marred by one disagreeable feature, namely, the selfish efforts of the Marconi Co. to sow discord, and to discredit beforehand the results of the Conference. Its attempts through the daily Press to prejudice the situation with inflammatory suggestions deserve the severest condemnation. They are all the more unwarrantable since the Marconi Co. itself had already entered into a new agreement with the Postmaster-General, touching the very provisions now agreed to at Berlin. In that agreement, which was laid on the table of the House of Commons in April last, it is provided in Clause 10 that in the event of the British Government concurring in the stipulations of the Berlin Protocol, the Marconi Companies undertake to observe the provisions of the Convention, and in particular undertake to accept the obligation to interchange messages with ship and shore stations equipped with other apparatus.

It is scarcely credible, and is indeed most discreditable, that the Marconi Companies having already entered into such an agreement with the British Government, should have taken the course they have done during the last few weeks in embarrassing the Government and sending hostile letters to the Press. Such action is perilously near a breach of good faith. It is essentially un-English.

REVIEWS.

Air Compressors and Blowing Engines. By Chas. H. Innes, M.A. Manchester: The Technical Publishing Co. 1906.

Originally a series of articles in a contemporary, the *Practical Engineer*, this book deals with the theory of air compression, and the practice of blowing engines, the majority of this part of the work being foreign, though one or two English-made blowing engines are illustrated. Still this part of the book conveys too much the idea of compilation along the lines of least resistance. The remainder of the volume deals with air compressors, and, though to a less degree, also draws considerably on foreign sources.

In the first part the author considers the general question of air compression in reference to isothermal or adiabatic expansion, and takes into his calculation the effects of clearance and cooling. The author is nothing if not mathematical, and he is not blessed with the best selection of letters and symbols, nor has he much pity for readers, who would get along much better if diagrams were repeated on various pages to avoid the turning back for reference, which is now as necessary as it is irritating.

We find mechanically-operated valves well treated of, but extremely little as to the *raison d'être* of such valves. Equalisation valves are also described, the equalisation valve being a device which allows the air compressed into the clearance space to escape into the opposite end of the cylinder after discharge is over. This, for course, represents so much more air to be compressed per stroke, for the clearance space is relieved almost to atmospheric pressure, and the air escapes and adds to the air already present in the other end of the cylinder, which has already been drawn full at atmospheric pressure. The work done in compressing into the clearance space is not recovered fully, but some of it is, since its escape into the opposite end results in compression of the air therein to a pressure above atmospheric before the piston moves.

Probably to the young student and draughtsman the fact that the blowing engines described and illustrated are so largely foreign may not be a drawback to the book, for his acquaintance with foreign work may not be great, and it is certain there is much to be learned, even if something to be avoided, in the products of the foreigner, whose practice usually is apt to tend in the direction, perhaps, of over elaboration. Blowing engine practice has changed considerably from the days when the beam engine was the type. To-day the vertical direct-acting blowing engine is more usual, or the horizontal form in foreign practice.

In the air-compressor section the various well-known types are described, including the Brotherhood, which is made for very high pressures, even up to 2,500 lb. per sq. in. Curiously at a time when the turbine has been forced so much to the front, that it has been pressed into service as an air compressor, we find no reference to it in this book. It would have been just as well to name it, however, though, whatever the advantages of a turbine as a motor, we are not among those who feel that it can strictly be considered as reversible. No doubt it will reverse and will compress air, but the economy and efficiency of the reversed process are doubtful.

As with blowing engines, so also with air compressors the valves may be automatic or they may be mechanically operated. The latter are described in various forms. The chief object of the mechanically operated or controlled valve is, next to its proper function, to avoid shock. Hence some valves are only controlled so far that they are brought near to their seats as the end of the stroke is approached, so that when the time for closing arrives they shall not have far to travel, and shall close without shock, the control device then leaving the valve free to open fully so as to avoid throttling.

The subject of the mechanical movement of air is not generally well understood, and those who would know more may turn to this book with advantage.

Polyphase Currents. By A. Still, A.M.I.C.E., M.I.E.E. Whittaker & Co. 1906. Price 6s. net.

The name of this author is familiar to all who have studied the theory of alternating currents, as he has written a well-known book on the subject, and several papers. In particular, we recall the important paper on the regulation of the voltage of networks, which, in conjunction with Mr. E. W. Cowan, he read to the Northern Society of Electrical Engineers in 1896. The present work is written for the electrical engineer, and the mathematical knowledge assumed on the part of the reader is of the slightest. It deserves to be widely known, and forms an excellent introduction to the practical theory of alternating currents.

It does not follow from the absence of symbols that there is little mathematical thinking in the book. On the contrary, many of the graphical methods explained give approximate solutions of some difficult problems. A more exact solution of some of these by analysis, although possibly not difficult to the mathematician, would be laborious or impossible reading for the engineer. In a few cases the reader would welcome a little more explanation. For instance, it is encouraging to find that the young engineer will in all probability be able to prove for himself that "the steepness or slope" of a curve is an exact measure of the rate at which the ordinate increases (p. 47).

Our experience has been that in nine cases out of ten he gets muddled over the meaning of "rate." On p. 126, also, it is not quite obvious that the lines A a, B b and C c meet in a point. Some readers would be glad of a geometrical proof—if such a proof can be given. It is not obvious from first principles that all the vectors shown lie in one plane.

In the first three chapters the elementary theory of alternating currents is explained. The fourth and fifth chapters discuss the measurement of power and the theory of polyphase transformers. The sixth chapter is a useful introduction to the theory of power transmission. In the final two chapters a slight sketch is given of the theory of induction motors and rotary converters.

It is a pity that the author defines "angle of lag" and "phase difference" as synonymous terms. This leads to a mistake on p. 25.

It is stated that if the voltage across the terminals of two alternators in series be equal to the sum of their voltages, then the machines are in phase, "although it is quite possible that the maximum values of the component

E.M.F.'s might not be reached at the same instant of time. . . . ." It can be shown that if the voltage across the extreme terminals equals the sum of the two component voltages, then the waves produced by the two alternators must be similar in form, and hence, they must attain their maximum values at the same instant.

On p. 94, when discussing the circulating current in a mesh-connected armature, it is stated that "the function of this internal armature current is to maintain the potential differences at the three terminals such that their sum is, at every instant, equal to zero." The sum of the potential differences at every instant, however, must always be zero whatever values the currents have, so this does not give us the slightest help in understanding the phenomenon. Again, on p. 107, we read: "The reasons which make it impossible to run synchronous alternators when coupled in series do not require a detailed explanation; the current being necessarily the same through all the armature windings, no interchange of synchronising currents can take place between the various machines. . . . ." Surely, when two alternators are running in parallel on no load, the current is necessarily the same in the armature windings of each, and yet an exchange of synchronising power takes place? Steinmetz also pointed out some years ago that "n" alternators will run in series in stable equilibrium on no load, and "n" phase currents can be taken from their terminals without disturbing the equilibrium. This theorem was considered worth an expensive patent.

On p. 166, when explaining the skin effect, it should be stated that the distribution of the current depends on the position of the return conductor. Kelvin's formulæ, from which we suppose fig. 61 is calculated, are obtained on the supposition that the return conductor is at an infinite distance. In a concentric main the current soaks into the inner conductor from the outside and into the outer conductor from the inside. The latter effect is quite as important as the former, and Heaviside has shown that the formulæ for the two cases are quite different.

The formula given on p. 181 for the capacity of two parallel conductors is only true when the radius of either is small compared with the distance between them. For instance, when they are very close together, the capacity is infinitely great, and is not 0·065 microfarad per mile, which the formula would give. The true formula is very simple.

There is some confusion about the definition of "slip." On pp. 259 and 297 the "slip" is taken to mean the difference of the speeds of the rotor and the magnetic field, but on pp. 263 and 264 it is taken to be the ratio of two E.M.F.'s. It is proved on p. 263 that the torque varies as the C^2R loss in the rotor and inversely as the "slip." The reader will probably, therefore, have difficulty in understanding why if R be so small as to be considered negligible, there will be no limit to the permissible amount of overload (p. 258), seeing that the torque is proportional to R, and the speed of the rotor is practically constant.

On p. 293 it is not explained why crossing the connections of any two of the terminals of a three-phase motor reverses the direction of rotation of the field. The practical man reads a book to find out the reasons of these things. In discussing rotary converters on p. 322 it is stated that "the output of these machines—*except in the case of the single-phase converter*—is always greater than that of the same machine used merely as a direct-current generator." We think this statement too sweeping. The outputs of converters depend on the power factor on the A.C. side, and on the efficiency of the machine, and if these are not very high the above statement is not correct. The table of relative outputs for polyphase converters given on p. 323 needs revision. It is got on the assumptions that the efficiency of the machines is 100 per cent., and that the number of commutator bars is infinite. It is not safe to assume that "There will always be a greater amount of heat generated in the neighbourhood of the points of the winding from which the connections are taken to the slip rings." In a two-phase converter this will only be true when the power factor is unity.

In Note 1 the coefficient of self-induction is defined. The definition given is only true for an infinitely thin wire, in which case, unfortunately, it is equal to infinity. The author extends his definition so as to include the case when the permeability of the field is not constant, but the coefficient defined is itself a variable, and thus can be of little practical use.

There are very few misprints. On p. 109, 2·13 EC should be 2·12 EC. On p. 111 we have the figure 61·23, but from p. 318 we gather that it should be 61·24. It would be better, however, to give it as 61, as considerable assumptions have to be made in the proof.

On p. 277 the denominator of the algebraical fraction should be k_m^2 and not k_m. We presume also that (p. 321) "sparkling" in connection with the commutator brushes is a misprint for "sparking."

Electric Wiring. By W. C. CLINTON, B.Sc. Fourth edition. London: John Murray. Price 2s.

This book is for the use of wiremen and students, and aims at teaching these the elements of electric wiring. It would be unreasonable to complain of omissions in this useful little book of 200 pages. There are men now in this overcrowded wiring industry whose knowledge could be summed up in a dozen pages or less, yet this primer does not pretend to be more than an introduction to the subject. Its pages are not overloaded with points best learned by an apprenticeship; yet it gives, within its self-imposed limits, an orderly and lucid exposition of the primary essentials of electric light and bell fitting.

The practical units and their application are first explained, then most of the everyday circuit arrangements. Conductors, insulating materials, wood casing, conduits and things relative to these, and methods of jointing and fixing them are described and very fully illustrated. Typical switches, fuses, lamps and fittings are pictured, and problems of illumination are glanced at. Some space is devoted to electric bell and "alarm" connections. A few useful tables and a series of questions with fully worked out replies are given; and a final chapter on testing concludes the whole.

The two systems of conduit selected to illustrate the cheaper and better class work respectively are not now in high favour with engineers of experience, as compared with solid drawn or welded enamelled tubing. Nor would such men willingly sink wood casing in plaster, at least not so as to have the capping flush with the plaster, with the idea of convenient after-inspection. Even with beading at the edges this makes a bad finish, and if tight, the removal of the capping would risk small fractures of plaster edge.

The author points out the disadvantage of breaking the middle wire, after it enters the house, but he does not refer to the danger of sudden rise of pressure in "mid" wire over earth potential due to various common accidents, or testing disconnections, in the supply company's cables. When a building is shut down, it is well to be able wholly to disconnect from the supply mains. This, of course, is now done by branching the "mid" wire near where it enters, not as shown in fig. 57, but right and left to two main switches and fuses; one of these is coupled to form a D.P. fuse and switch with the positive fuse and switch, the other with the negative fuse and switch. Then the "mid" cannot be opened without opening an "outer" positive or negative also.

Looping-in is popular at present, and certainly affords some relief from bad jointing. It is often applied, however, to circuits which would be much simpler to erect, maintain, trace and repair, if fitted with well-made branch joints in proper boxes. Such mistaken applications of looping-in are part of the penalty paid for the prevailing inefficiency of workmanship, which in turn is a result of the passing mania for the competitive tender.

On p. 159, the lower part of fig. 77 from p. 158 opposite is repeated. Articles such as figs. 45 and 46 could, with advantage, be drawn with their wires in position.

But these are minor faults. The book may be recommended, not merely to the plumber who seeks to pose as an electrician, but to wiremen, and to students preparing for the preliminary examinations of the City and Guilds of London Institute.

SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

Advertising.*

Personal canvassing is of the utmost importance, but it is not all; it needs to be allied with that powerful assistant, newspaper and "direct-by-mail" advertising. A persistent and systematic course of advertising is most necessary, and it should not merely be the ordinary style, but more especially that which is educational in its nature, bringing forcibly to the front the many advantages and economies of electric light and power. It is wonderful how ignorant the residents of the average town still are concerning electricity and its applications. They hardly know whether a shop is lighted by electricity or not, though they appreciate the fact that one shop is better lit than another, or notice that they can match colours more correctly in some shops than in others. But, unfortunately for the central station manager, they do not often realise that the light they find most efficacious is due to electricity. Therefore it becomes his aim to enlighten them, figuratively speaking as well as literally.

A very successful means of educating the general public is by the distribution of a well-edited and interesting monthly magazine. Such a publication appearing regularly month by month has a cumulative value far exceeding in effectiveness that of any haphazard scheme of advertising which has as its basis the spasmodic circulation of a series of cards and hand-bills which have no apparent relation to one another.

The monthly magazine presents itself as the dignified representative of the central station. Through it people become familiar with electricity, which gets to be a household word, talked of at the table, a familiar topic instead of a mysterious, far away, dimly understood subject, and time-worn expressions to the effect that electricity is only in its "infancy" become relegated to the past.

A central station magazine is not an untried novelty, but a proved success. Those undertakings that have adopted it would not now give it up, as they find that it makes an impression that no other form of advertising could accomplish. It saves the canvasser much explanatory work, and aids him considerably in the securing of new business.

As to the contents of such a publication, they should comprise brief well illustrated notes concerning the use of electricity in the home, in the shop and in the factory, and its relation to comfort, health and economy. They should cover, broadly, portions of the whole field of electricity in each number, so that there may be something of interest for every reader. A page or so on labour-saving devices for the household, a few paragraphs on decorative lighting for the home, something about electric signs and window display for the shop, and a column or two on motor installations for the factory—all freely illustrated by attractive sketches and reproductions of photographs. In addition a few jokes or humorous tit-bits may be judiciously introduced. Also local items of news concerning matters electrical, changes of policy or prices, a list of the local wiring contractors and electric supply dealers, and many other things that a prospective customer should know.

The cost of such a publication could be defrayed either fully or in part by the insertion of advertisements, but it is a moot point as to whether or not this is advisable, for though on the one hand the advertisements may be said to divert attention from the reading matter, yet on the other hand, the reading matter might be considered to stand out with more prominence owing to the fact that it is not displayed and therefore affords a sharp contrast on account of its proximity to the displayed advertisements.

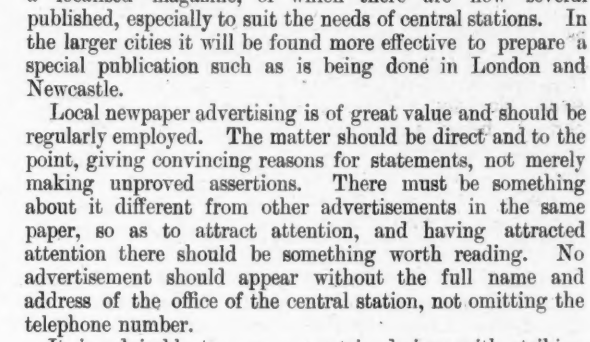
Undoubtedly the best method of distribution is by post; this is a little more expensive than taking them from door to door, but on the other hand, it is more certain. The posting should be so arranged as to ensure the delivery being made by the first post in the morning, as this is the mail of the day that usually receives the best attention in the home and at the office.

An unstamped post-card, addressed to the office of the central station, should be enclosed with each copy of the magazine. On the back of these cards, a request for a call from a representative should be printed, and blank spaces left for the signature and address of the recipient of the magazine, and also for the insertion of a convenient day and time for the call.

In the smaller towns the cheapest plan will be to employ a localised magazine, of which there are now several published, especially to suit the needs of central stations. In the larger cities it will be found more effective to prepare a special publication such as is being done in London and Newcastle.

Local newpaper advertising is of great value and should be regularly employed. The matter should be direct and to the point, giving convincing reasons for statements, not merely making unproved assertions. There must be something about it different from other advertisements in the same paper, so as to attract attention, and having attracted attention there should be something worth reading. No advertisement should appear without the full name and address of the office of the central station, not omitting the telephone number.

It is advisable to vary geometric designs with striking cuts. Certain of the manufacturers are glad to provide cuts of their apparatus, and other suitable electrotypes may also be obtained at very reasonable prices from the various advertising specialists. The latter also undertake to supply matter for the body of the advertisement, thus saving the


ORDER. SATURDAY, MAY 12, 1906.
ENT IN CIRCLES
to be Worked Evening.
HRONICLINGS
Luminous Electric Radiators.
THIS illustrates an Electric Motor driving a meat chopper. It will also drive most any thing else.
EDISON NEWS
Have you noticed that we are giving live, fresh news concerning the applications of our EDISON ELECTRIC LIGHT AND POWER in this space EVERY DAY
Edison Electric Light and Power Co.,
Hall 'Phone 19-J
80 E Main St. Amsterdam. Auto 'Phone 82.
SCHUBERTS AND

central station manager's time; and owing to its being prepared by men who make the art of advertising their speciality, such matter is usually much more satisfactory than an amateur production. It is advisable, however, for the manager to edit these ready-made advertisements, as they do not always exactly fall in line with local requirements.

The illustration given above is an example of a type of advertising that has been used by the writer, which is somewhat of a departure from the usual methods. It is a 15-in. space, 10 in. of which is used as an ordinary display advertisement, changed once a week, while the remaining 5 in., on the left hand side, consist of Linotype matter which is changed every day. The advertisement appears daily in the same space in the paper, ordinary news usually appearing at one side and partly underneath it—an arrangement which makes the people more liable to read the paragraph than if its appearance as an advertisement was more clearly defined.

The object of changing the matter every day is two-fold: first, to attract attention, and secondly, to bring before the public various items concerning electricity, items of which it is to the advantage of the central station that they should be informed. Thus the paragraph becomes an educational factor as well as an advertisement.

* Previous articles of this series appeared on pages 650-1, 656-7, and 728-9 of the current volume.

Newspaper advertising brings about friendly relations with the editor, a state of affairs which is of considerable value, as in an indirect way it is apt to lead to the modification of many of those careless and sensational paragraphs which come into an editor's hands from time to time and do a good deal of damage to a central station business by exaggerated accounts of mishaps. Advantage may also be taken of these friendly relations to supply the editor with interesting paragraphs, "readers" and "fill-ups," dealing with electrical matters in general, all of which tend to the general awakening of public interest in electrical supply.

The manager must be careful to observe any points in the local papers which may be useful to him in his business. Announcements of the erection of new houses, the alteration or extension of present buildings, the prospective opening of new shops, all of these will present possibilities of new business, and must not be overlooked. It will also be found a good plan to clip from the local newspapers any items dealing with electrical matters in general, and the local electric supply service in particular. These cuttings entered into a scrap book will be useful for reference, as it is desirable to keep track of the amount of notice that is being given in the local Press during different periods.

Attractive Showroom.

One of the most important and live advertisements a central station can have is a showroom (part of which can be used as an office) in the main business thoroughfare, and on the "right side" of the street. Everyone comes down the main street at more or less frequent intervals, and the show window will become to the passers-by a silent, yet speaking reminder of the existence of the central station, and also an important educational factor.

This is an apparently expensive reminder, but if the show-window is kept bright and attractive-looking, and if its display of labour-saving and comfort-giving electrical appliances is constantly changed, then it will be found that the expense is fully justified. Another point in favour of a showroom in a prominent position is that if people pass it often they are very likely to drop in and make inquiries, so that the assistant in charge has more frequent opportunities to explain and demonstrate the methods of using the appliances exhibited in the windows.

The store should be provided with a convenient supply of current, in order that the operation of various types of lamps and other apparatus may be shown to customers with facility. If a showroom can be obtained in a position in which it can be used to accommodate the general public as a waiting room for the trams, this will add considerably to its value as an advertisement. Near the cashier's desk a shelf or stand should be arranged on which to place some interesting piece of apparatus each month, or each quarter, about the time that bills become due. Then when a customer comes to pay his account, his attention will be attracted by this stand, and while waiting he will investigate the article; for instance, if a flat-iron is the article shown, the current should be applied, and a card placed beside the apparatus stating that it is "hot." The customer naturally is at once curious to test the heat and thus gets a convincing evidence of the possibilities of such device. By the time his receipt is ready, it is more than likely that he will be favourably disposed to listen to the cashier's offer to arrange to have one sent to him on trial.

One or more meters should be installed and so connected as to demonstrate to a customer how such instruments register directly in proportion to the load upon them, and also to explain how they are read.

Labour Troubles at Berlin.—A slight dispute has just arisen at Berlin in connection with new working rules which have been introduced by the Siemens-Schuckert Works Co. and the Siemens & Halske Co. by arrangement with the workmen's committees of both firms. It appears that in accordance with the wishes of many of the men, the working week, which until recently ranged from Thursday to the following Wednesday, has been altered to the calendar week and the wages paid on Thursday instead of on Saturday. The new rules also provide for a working day in the automobile factory of 8½ hours, as compared with nine hours formerly, but some of the men object to staying a further period of three-quarters of an hour as overtime, and objections are also raised to the change in the working week. The dispute has led to a strike of 1,500 workers, although the places of a number of these are reported to have already been filled.

SUCTION GAS v. STEAM.

[COMMUNICATED].

Although a great deal has been written on this subject, there are one or two points that have not so far been dealt with, and it is the object of this article briefly to consider a typical case of two generating stations of similar size, and with units of the same size installed. In the first instance, it may be stated that the whole question resolves itself into a consideration of the cost and quality of the fuel to be obtained in the neighbourhood of the proposed installation, as it is on this point that the matter mainly rests. At the same time it must not be forgotten that the capital cost of the installation has a very considerable bearing on the subject.

The installations under consideration each comprised three 200-KW. combined sets, which were supplied each by a separate boiler in the case of the steam plant, and with a separate suction gas producer in the case of the gas plant. The gas engines were of the four-cylinder vertical type, and the steam engines were of the high speed enclosed type. In each case the engines were direct-coupled to three-phase generators. The plant in the stations was as follows :—

Gas.—Three engine sets, complete with suction gas producers, and the necessary gas, exhaust, water piping and tanks, &c. ; two small starting engines with air compressors ; main switchboard and connecting cables ; overhead travelling crane.

Steam. — Three water-tube boilers, with mechanical stokers and superheaters, economiser and two feed pumps ; three engine sets, complete with one surface condensing plant, with steam-driven pumps ; steam, exhaust, feed blow-off piping, &c. ; with oil separator, hot-well tank, and all necessary drain piping ; main switchboard, and connecting cables ; overhead travelling crane.

The boiler pressure was 160 lb. per sq. in., superheated 120° F. The total costs were as follows :—

Power station plant with suction gas	£11,900
Buildings and foundations (approx.)	2,200
Total cost (gas station) ...	£14,100
Power station with steam plant...	£7,800
Buildings and foundations (approx.)	2,600
Total cost (steam station) ...	£10,400

I have not given the individual costs of the different apparatus, as such would not affect the points under consideration, but it is sufficient to say that the figures given in both cases are what the plants could be put down for.

It must be mentioned that in each of the above stations, one of the units was a spare. By units is meant one complete engine set with suction gas plant for the gas-driven station, and with boiler for the steam-driven station.

For the purposes of comparison, the cost of the steam coal was 6s. 6d. per ton, and the anthracite was 23s. per ton. Now when comparing these fuels, we will do so on the basis of the number of British thermal units each will produce for 1d.

The calorific value of the steam coal was 11,277 B.TH.U. per lb. Therefore—

$$\frac{11{,}277 \times 2{,}240}{78} = 323{,}852 \text{ B.TH.U. per 1d.}$$

The calorific value of the anthracite was about 12,550 B.TH.U. per lb. Therefore—

$$\frac{12{,}550 \times 2{,}240}{276} = 101{,}855 \text{ B.TH.U. per 1d.}$$

The above figures show a very great advantage in favour of steam, but this is largely neutralised by the greatly increased number of B.TH.U. required by the steam engine per kilowatt-hour.

The efficiencies of the different plants may be taken as follows :—

Gas.—Suction gas producers	80 to 85 %	
Gas engines	85 %	
Generators	93 %	
Steam.—Water-tube boilers	75 %	(thermal)
Steam engines...	91 %	
Generators	93 %	

The above figures are all full-load efficiencies.

The water-tube boilers would have an evaporation of about 8¾ lb. of water per lb. of coal when evaporating from and at 212° F., and the Lancashire boilers would have an evaporation of, say, 7 lb., under the same conditions.

The gas and steam consumptions would be as follows :—

	Full load.	¾ load.	½ load.	
Gas.—97 0 cb. ft.	105·0 cb. ft.	116·2 cb. ft.	per KW.-hour.
Steam.—21·7 lb.	23·3 lb.	26·1 lb.	,,

The steam figures are with 155 lb. working pressure, superheated 120° F., and condensing with 26 in. vacuum.

With the above figures as a basis we can now consider the works costs of the two types of stations, with two of the 200-KW. sets working at approximately three-quarter load for 10 hours per day and 300 days per year. This will be very nearly the actual load of the plant when the station is used for supplying power and light to a factory, which is what the station was designed for. Of course the lighting load will affect the figures somewhat, but it would only be to improve them.

The number of units generated will be 900,000 per annum.

Gas.—Cb. ft. of gas required, 900,000 × 105 ...			94,500,000
Which at 79 cb. ft. per lb. of coal, gives us ...			1,196,200 lb.
Add for losses, say			111,270 ,,
Total coal...			1,307,470 lb.
At 23s. per ton, this will cost—			
$\frac{1,307,470 \times 23}{2,240}$	£671	5s., or	·18d. per unit.
Oil required will be 6 gallons per day for two engines, giving 1,800 gallons per annum, at 2s. per gallon	180 0		
Waste, say, 600 lb. per annum, at 9d. per lb.	30 0	or	·056d. ,,
Water, say 2,161,000 gallons, at 6d. per 1,000 gallons	54 0	or	·0144d. ,,
Wages, say per annum	450 0	or	·12d. ,,
Total works costs ...			·3704d. ,,
Repairs and Maintenance.—			
5 per cent. on plant, £11,900	595 0		
2 per cent. on buildings, £2,200	44 0	or	·170d. ,,
Interest and Depreciation.—			
10 per cent. on plant, £11,900	1,190 0		
7 per cent. on buildings, £2,200	154 0	or	·358d. ,,
Total costs			·8984d. ,,

Steam.—Under the same conditions of working as for the gas plant, the amount of steam required will be 900,000 × 23·3 = 20,970,000 lb., which at 8¾ lb. evaporation 2,396,670 lb. of coal
Allow for losses, &c. ... ... 450,000 lb. of coal

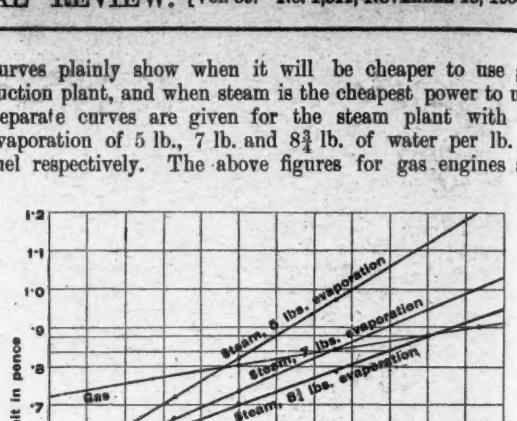
Total coal ... ... 2,846,670 lb.

2,846,670 lb. at 6s. 6d. per ton ...	£413	5 or	·11d. per unit
Oil and Waste, &c.	63	0 or	·018d. ,,
Water, say, 1,300,000 gallons per annum at 6d. per 1,000 gallons	32	10 or	·009d. ,,
Wages, the same as for gas-driven plant	£450	0 or	·12d. ,,
Total works costs...			·257d. ,,
Repairs and Maintenance.—			
5 per cent. on plant, £7,800 ...	£390	0	
2 per cent. on buildings, £2,600	52	0	or ·120d. ,,
Interest and Depreciation.—			
10 per cent. on plant, £7,800 ...	£780	0	
7 per cent. on buildings, £2,600	182	0	or ·260d. ,,
Total costs...			·637d. ,,

Even on the works costs it will be noticed that there is an advantage in favour of steam of ·113d. per unit, which is increased to ·261d. when the capital charges are taken into account, owing to these being much less for steam than for gas. If there was only an evaporation of 7 lb. of water per lb. of fuel, the cost of the coal per unit would be ·14d.

All the above figures are based on actual figures given by the manufacturers of the different types of plant, and in actual working they will probably be increased in both cases by ·1d. to ·15d. per unit. However, as the gas and steam figures are considered on the same basis, it is only reasonable to presume that the gas-engine people have stated the utmost their plant will do, the same as the steam-engine people.

To facilitate comparison of these plants the writer has got out the following curves, showing the respective costs per unit for gas and steam at different prices of fuel, of course assuming the calorific values mentioned previously. The curves plainly show when it will be cheaper to use gas suction plant, and when steam is the cheapest power to use. Separate curves are given for the steam plant with an evaporation of 5 lb., 7 lb. and 8¾ lb. of water per lb. of fuel respectively. The above figures for gas engines are



Total costs based on an output of 900,000 units from two 200-KW. generating sets working at ¾ load for 10 hours per day, and 300 days per annum.

with special fly-wheels, flexible couplings, &c., suitable for running the alternators in parallel, but if they were for driving continuous-current generators in parallel the total cost would be reduced about £1,000. Further, if horizontal gas engines were used for driving the alternators by ropes, there would be a reduction of a similar amount ; whereas, if they were driving continuous-current generators, the total reduction would be only about £1,400 from the figures given for the vertical engines driving alternators. In the case of the horizontal engines, however, it must not be forgotten that a larger engine-room would be required ; and when this is taken into account, together with the extra foundations necessary, this type of plant will be quite as costly as the vertical engines, besides being less efficient.

ELECTRICITY IN BRAZIL.

By W. WHYTE GAILEY, A.M.I.E.E., Assistant Electrical Engineer, Sao Paulo Railway.

SINCE the appearance of my article on "Electricity in Brazil" in the ELECTRICAL REVIEW of June 23rd, 1905, the supply of electricity in Brazil has continued to spread and increase generally. Existing plants have been increased and modified, and new plants have sprung into existence, notably the large new scheme for supplying Rio de Janeiro with energy derived from falls on the River Parahayta, and transmitted overhead 112 miles at 60,000 volts, by the Rio Tramway, Light and Power Co. (Canadian Syndicate). Another important plant has been installed at Campinas, with Brazilian capital by American Construction-Engineer Dr. A. Byington ; power being furnished by falls at Joaquim Egydio, 25 miles distant. This company is also owner of the local gasworks. Santos City Improvement Co. has modified its old plant, having installed a Dowson gas plant ; it generates single-phase alternating current, and is the only company I know of, which uses English material. Stone's (English) electric lighting system is largely used on the railways of Brazil, but on account of non-representation of English firms in Brazil, the idea is gaining ground that England, as regards electrical work, is behind the times, and does not make or supply up-to-date electrical material, *e.g.*, A.C. transformers, arc lamps, alternators, H.T. line insulators, water turbines, &c., and especially telephones.

I have never seen an up-to-date English-made telephone or telephone switchboard here. All these are ordered from the States or Germany.

The following information may be useful to manufacturers. We generally allow on all engineering and electrical material 40 per cent. *ad valorem* to cover—packing for sea voyage, consul's dispatch, sea freight, Custom duties, Government duties, dock dues, and land freight from factory to point of use.

Here are particulars of duties on electric material in constant use.

Insulators.—100 reis (1·7d.) a kilogramme. If they have iron bolts or pins, the iron pays separately $2.500 (42d.) a kilogramme. Worked brass, *i.e.*, fittings, pay $4, *i.e.*, 5s. 8d. a kilogramme, if nickled, $8 (11s. 4d.) a kilogramme.

Electric bells pay heavily, $4 (5s. 8d.) a kilo., which works out up to 200 per cent. *ad valorem*.

Bare copper wire pays 30 per cent. *ad valorem*, or 400 reis (6·8d.) per kilo.

Insulated wire pays 20 per cent. *ad valorem*.

Bare iron wire, galvanised or not, pays 100 reis (1·7d.) a kilo.

Engines, turbines, motors, transformers, &c., pay 15 per cent. *ad valorem*.

Alternating current is almost exclusively used in Brazil, owing to the general use of convenient water power, which usually has to be transmitted some distance.

There is still opportunity for representation by English electrical firms in Brazil, and good prices can be obtained, as sellers of electrical material are seldom satisfied with less than 100 per cent. American and German firms have the market almost entirely to themselves, and unless English electrical firms soon obtain a footing in Brazil, South America will be closed to English electrical enterprise.

I have known of a case of an engineer here requiring lathes, machine tools, and other appliances requisitioned from England to be supplied with direct-coupled motors, — revs., — phase, — cycles, — volts, and have seen replies stating that the firms applied to only go in for D.C. work. Those at home do not realise the difficulties that hamper engineers so far away when ordering material.

We want a certain article, and we write to England and the States. From England we receive indifferently printed catalogues and a vague letter saying they will supply prices on receiving a thorough description of the article wanted. From the States, catalogues printed and illustrated beautifully on rich paper, full price lists, order forms; the last-named only to be filled in to describe exactly our requirements. Is it any wonder that the order invariably goes to the States?

Telephone switchboards are either American or Ericsson. Telephones are almost universally of Kellog or Berliner make, especially Kellog.

It is becoming more and more difficult each day to boom English electrical material in Brazil. I have been told many times that England has no up-to-date electrical machinery, for it is never seen here.

Are the markets of South America to be abandoned by English electrical firms? Are South Africa, Australia and Japan to follow, and in the end not even England be left for the English?

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer.]

No. 58.—Income-Tax.—Meters.—Deductions for Depreciation.

"Income-Tax" writes:—"An Irish client of ours has put the following question to us, and we should be glad if, through your 'Legal Column,' you would give us the requisite information:—When making up our yearly accounts we allowed for depreciation 5 per cent. on all plant except meters, on which we allowed 10 per cent. The income-tax assessor reduced this to 2½ per cent. on the plant and 5 per cent. on the meters. We should be greatly obliged if you could let us know if there is a fixed legal amount, or if it depends upon the income-tax assessor."

*** It seems to be clear that the amount of the deduction for depreciation may be settled by the Commissioners, for it is provided by Sec. 12 of the Customs and Inland Revenue Act, 1878, that notwithstanding any provision to the contrary in any Act relating to income-tax, the Commissioners may allow such deduction as they may think just and reasonable as representing the diminished value by reason of wear and tear during the year of any machinery or plant used for the purposes of the concern, and belonging to the person or company by whom the concern is carried on. In the case suggested, the Commissioners have made their adjudication. It is a question of fact whether it is reasonable or not.

The following case may be of service to "Income-Tax":—In the Leith, Hull, and Hamburg Steam Packet Co. *v.* Bain (1897), 3 Tax, Cases 560, a company owned a fleet of passenger and cargo steamers. The Commissioners allowed a deduction of 5½ per cent. from the written-down value of the whole fleet in the company's books, as representing the diminished value of the ships by reason of wear and tear during the year of assessment. The company claimed a reduction of the assessment on the ground of overcharge consequent upon insufficient allowance for depreciation. It was held that the appeal must be refused.

No. 59.—By-Laws.—Local Authority supplying Electricity.—Authority to enforce performance of.

"Inquirer" writes:—"With reference to the note on page 832 of your issue dated May 25th, headed "Breach of By-Laws," I should be glad to know under what authority a *Corporation Committee* have power to reprimand and fine a person for breach of by-laws. If the Oldham Committee have power to do this, does this apply equally well to Electricity Committees in all towns?"

*** Sec. 6 of the Electric Lighting Act, 1882, authorises any local authority within any part of whose district electric light is authorised to be supplied under any provisional order, from time to time to make, alter or repeal by-laws for further securing the safety of the public, any such by-laws being subject to confirmation by the Board. Up to February, 1903, no such by-laws had been made. Where, however, local authorities are themselves the undertakers, they have by special Acts of Parliament obtained power in many cases to make by-laws and regulations—without the necessity of having the same first approved by the Board of Trade; but in later cases this approval is insisted upon in all cases by Parliament.

A VISITOR'S IMPRESSIONS OF THE "UNDERGROUND."

No one who makes the shortest trip in a District train can help seeing that the present lamentable state of affairs has been brought about, to some extent, by a bad start, for the whole business is American to the backbone, and will have to suffer for it in an alien country.

The intention of the saviours of the undertaking was to show the half-alive Englishmen how a city line ought to be equipped and operated, and they have succeeded in teaching themselves as good a lesson as their compatriots have been taught over the New York Subway, if we are to believe the reports which have been circulated about the latter.

When the fares agitation was at its hottest last month, the *Times* published an article (Financial Supplement, October 10th) giving reasons for the action of the company in raising fares. It showed that the average train load is over 20 per cent. less now than it was in the last of the steam years, and thinks that the train mileage has increased out of all proportion to the earning power. At the same time, the seating capacity of the average train of four bogie cars is but 175, against a possible 300 if the compartment system had been retained. No one, of course, would suggest that the company should return to the compartment dimensions of the old stock, which were so cramped that a train of four four-wheeled coaches held 200 passengers; but there is not much doubt that the present cars were designed to accommodate strap-hangers during the rush hours, and that there never was any serious intention of seating everyone at all times. Americans take to such exercises as strap-hanging and bumper-balancing from birth, but the English require more education in these things, and take to it hardly at present. Not that overcrowding was unknown in the sulphurous days, but obviously, after the figures quoted, not to the present degree. Anyhow, the feeling is strong that sitting is more comfortable than certain forms of standing, and that a really modern train ought to provide more opportunities for it, although the less irate recognise that the waves of traffic at certain hours must overwhelm any reasonable amount of seating accommodation.

It is too much to expect the company to scrap the new stock after a year's use, and the writer sees in them a number of advantages which may not be obtainable in even the most modern compartment cars, but he will not be surprised if no more orders are placed for that design; and if all we hear is true, as it never is, the life of the present cars will be short enough to satisfy their critics and too short to please their proprietors.

Sir George Gibb has said that these trains cost £20,000 a year more in labour than they would if they required only a driver, stoker, and two guards like the steam trains, and by the elimination of the stoker the saving would be greater still.

The impression of the layman passenger has been for some time that the trains, or the rails, or something less obvious, make a great deal of noise, and that the operation of braking is often unpleasant to feel and hear. The more learned in these matters talk of shoddy trucks, and the gloomy necessity for an early renewal of rails, if travelling at the moderate speeds now in vogue is to be possible for the man of average sensibility.

Those readers who are taking an interest in the rail corrugation mystery, as it is sometimes called, besides those who are interested in the underground railways particularly, can observe for themselves when travelling over the lines a phenomenon which is almost certainly due to the trucks. The inside of the outer rail of one track, as seen from a car on the other line, is being cut away by the wheel flanges in an alarming manner, and very few lengths have escaped.

Generally speaking, a length of cut rail is succeeded by an approximately equal length which is untouched, but the lengths vary from a few feet to several yards, and often 100 yards or more is dull or bright as it happens to be free or cut. It seems to the writer that the phenomenon occurs, more or less rhythmically, whether the line is straight or curved, but his observations were restricted to what he could see as the train moved along, and he has had no further opportunity to note whether more than one rail is affected, but there is no reason to suppose the action to be so limited.

Evidently the trouble is an old one, and we shall be glad to hear from the engineers how it is caused and what is the remedy.

The writer's impression of the electrified Underground is that the Americans might have learned a good deal in England without spending so much money on failures, and he would have been really sorry for the damage which this business must have done to their name if they had not been so tarnation bombastic at the outset.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

12,491A. "Improvements in slotted armature cores for dynamo-electric machines." B. G. Lamme. (Date applied for under Patents Act, 1901, June 2nd, 1905, being date of application in United States. An invention comprised in application No. 12,491, May 29th, 1906.) November 2nd. (Complete.)

24,007. "Improvements in electric controllers." C. F. Barnholdt. October 29th.

24,059. "Improvements in and connected with electrolytic electricity meters combined with coin-freed devices." W. J. Wells and H. Fairbrother. October 29th.

24,078. "Improvements in and relating to binders for telephone switchboard cords." R. J. Skelton and A. H. Ware. October 29th. (Complete.)

24,084. "Improvements in or connected with magnetic compasses." A. F. Smith. October 29th.

24,156. "Improvements in coin-freed apparatus for administering electricity." W. A. A. Fricke, A. W. K. Witte and L. Mansfeldt. October 30th. (Complete.)

24,162. "Masts for space or wireless telegraphy." W. Fairweather. (The Brown Hoisting Machinery Co., U.S.) October 30th. (Complete.)

24,163. "Insulator for tension guys." W. Fairweather. (The Brown Hoisting Machinery Co. U.S.) October 30th. (Complete.)

24,179. "Improvements relating to electric incandescent lamps." F. W. Le Tall. (A. Lederer, Austria.) October 30th.

24,194. "Improvements in galvanic batteries." F. Jerabek. October 30th. (Complete.)

24,197. "Improvements in meters applicable for use in the supply of electricity, gas or the like, at two different tariffs." G. G. M. Hardingham. (The firm of Landis & Gyr (formerly Theiler & Co.), Switzerland.) October 30th.

24,208. "Improvements in and relating to controllers or cut-outs for electrical circuits." C. C. Garrard and Ferranti, Ltd. October 30th.

24,209. "Improvements in and relating to maximum demand indicators for electrical measuring instruments." C. C. Garrard and Ferranti, Ltd. October 30th.

24,230. "Improvements in and relating to the manufacture of incandescing bodies for electric lamps, furnaces and other apparatus." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) October 30th.

24,232. "Improvements in and in the manufacture of incandescing bodies, electric lamps and other apparatus." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) October 30th.

24,233. "Improvements in and relating to electric incandescent lamps having incandescing bodies of refractory metal." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) October 30th.

24,234. "Improvements in and relating to the purification of tantalum." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) October 30th.

24,235. "Improvements in and relating to metallic incandescing bodies for electric lamps and other apparatus." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) October 30th.

24,236. "Improvements in and relating to the manufacture of incandescing bodies for electric lamps, furnaces and other apparatus." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) October 30th.

24,239. "Improved method of and means for electrically-driving printing and other machines." W. A. Mitchell. October 30th.

24,242. "Improvements in and relating to electric meters." The British Thomson-Houston Co., Ltd., and F. Holden. October 30th.

24,243. "Improvements in and relating to dynamo-electric generators." The British Thomson-Houston Co., Ltd., and B. Hopps. October 30th.

24,245. "Improved magnetic automatic cut-out." A. A. Andrews and G. H. Wilkins. October 31st.

24,249. "Accumulator protector." W. S. Kneeshaw and R. G. Williams. October 31st.

24,291. "Improvements in ignition apparatus for internal combustion engines." E. G. Gosset-Tanner and R. T. Deane. October 31st.

24,296. "Improvements in or relating to apparatus for subjecting gases to the action of electric arc flames." A. Mahlke and G. Brion. (Date applied for under Patents Act, 1901, November 3rd, 1905, being date of application in Germany.) October 31st. (Complete.)

24,330. "Battery testing apparatus." E. Fauvin, E. Amiot and E. Cheneaux. October 31st. (Complete.)

24,336. "Improvements in and relating to electric current converting dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 31st.

24,337. "Improvements in and relating to electric transformers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 31st.

24,338. "Improvements in and relating to electrically-driven vehicles." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 31st.

24,346. "Improvements in safety fuses for electrical circuits." M. Mehlhardt and W. Schussler. October 31st. (Complete.)

24,361. "Improved multiple holder for electric incandescent lamps." G. Wallace. October 31st.

24,363. "Improvements in alternating polyphase motors." J. W. Mackenzie. (La Societe Alsacienne, France.) October 31st. (Complete.)

24,390. "Improvements in ears or supports for suspending electric trolley wires." R. E. Dixon and A. E. Dodwell. November 1st.

24,422. "Improvements in or relating to magnetic separators." M. Ruthunburg. November 1st. (Complete.)

24,445. "Improvements in fuses for electrical circuits." S. M. Kintner and G. B. Rosenblatt. (Date applied for under Patents Act, 1901, November 4th, 1905, being date of application in the United States.) November 1st. (Complete.)

24,446. "Improvements in and relating to electric transformers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 1st.

24,447. "Improvements in methods of and apparatus for the preparation of nitrogen-oxygen compounds from atmospheric air or from mixtures of nitrogen and oxygen by means of an electric discharge." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Gesellschaft, Germany.) November 1st.

24,448. "Improvements in and relating to electric motor-control apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 1st.

24,456. "Improvements relating to the conversion of electric currents. D. Timar and K. von Dreger. November 1st. (Complete.)

24,459. "Improved communication by telephone." J. H. Ruff. November 2nd.

24,465. "Auto-magnetic safety latch." A. E. Pettingell. November 2nd.

24,472. "Improvements in or relating to underground boxes or chambers used in connection with underground electrical cables and for other purposes." E. J. Chambers. November 2nd.

24,439. "Improvements in electrical braking of direct-current series or compound-wound motors." N. E. Naumann. November 2nd.

24,506. "Improved form of Nernst lamp for street lighting and other purposes." E. E. Hoadley. November 2nd.

24,532. "Circuit closer for trolley signals." A. Bevan. November 2nd. (Complete.)

24,536. "Improvements in and relating to electric transformers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 2nd.

24,576. "Improvements in flame arc lamps." C. E. G. Gilbert. November 2nd.

24,582. "Improvements in phase transformers, especially applicable to transforming single-phase electric currents to polyphase electric currents, or *vice versa*." Bruce Peebles & Co., Ltd., and J. L. La Cour. November 2nd.

24,589. "Separating solids from water in china clay and other similar materials by electrolysis." F. Moir. November 2nd.

24,632. "Improvements in variable electrical resistances." A. H. Mayes. November 3rd.

24,636. "Improvements in means for extracting pieces of iron and other magnetic substances from raw textile and other light materials." G. Whittaker and J. R. Ashworth. November 3rd.

24,669. "Improved inductor electric generators." P. Rabbidge. November 3rd. (Complete.)

24,682. "Improved box or covering for lead-cased electric cables." J. Stratton and A. A. Claremont. November 3rd. (Complete.)

24,683. "Improvements in and relating to alternating electric current distributing systems." Allgemeine Electricitats-Gesellschaft. (Date applied for under Patents Act, 1901, November 3rd, 1905, being date of application in Germany.) November 3rd. (Complete.)

24,685. "Improvements in the manufacture of incandescent electric lamps." W. Defries. November 3rd.

24,686. "Improvements relating to electric bells." I. B. Birnbaum. (F. Brinkmann, Germany.) November 3rd.

24,689. "Improvements relating to carbon holders for microphones." W. A. W. E. Hjorth. November 3rd. (Complete.)

24,694. "Improvements relating to microphones." R. O. P. Berglund, W. A. W. E. Hjorth and C. E. Ljungman. November 3rd. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Cathodes. H. S. Hatfield and The Reason Manufacturing Co. 20,770. October 18th.

Rotary Interrupters for Electric Currents. J. O. Heinze. 21,020. October 17th.

Electric Batteries. A. H. Fippard. 21,279. October 19th.

Manufacture of Electrodes for Electrical Accumulators by means of Continuously Operating Machines, and in the Electrodes and Accumulators thus Manufactured. E. W. Junger. 21,534. October 23rd. (Date applied for under International Convention, June 10th, 1905.)

1906.

Windings of Dynamo-Electric Machines and Electric Transformers. M. B. Field. 966. January 13th.

Battery, Coil, and Sparking Plug Testing Machine. E. Bristowe and G. Henman. 4,252. February 21st.

Wireless Telephony. H. Wesselius. 4,585. February 24th.

Electrical Resistance of Metals. H. Kuzel. 7,655. March 30th. (Date applied for under International Convention, July 28th, 1905.)

Conduits for Electric Cables and the like. L. Mannstaedt. 7,818. March 31st.

Trolley Heads for Electrical Tramway Systems. G. B. Holmes and A. D. Allen. 8,029. April 3rd.

Telephone Apparatus. R. Bines. 8,173. April 4th.

Liquid Electric Resistances. Felten and Guilleaume-Lahmeyerwerke Akt.-Ges. 8,657. April 10th. (Date applied for under International Convention, July 25th, 1905.)

Electric Switches, and Act uating means therefor, Operated in Accordance with the Direction of Motion of a Moving Part. Veritys, Ltd., and J. Dalziel. 8,715. April 11th.